PROJECT MANUAL

ELKHORN ELEMENTARY CAMPUS MODERNIZATION

10505 DAVIS ROAD, STOCKTON, CA 95209

DSA SUBMITTAL INCREMENT 1



04/09/2026

LPA Project No.: 31943

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SECTION 000105
CERTIFICATIONS PAGE

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DATE: 05/21/2026

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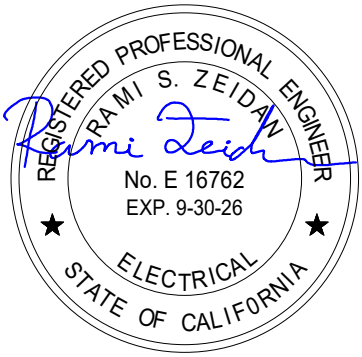
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END OF SECTION

SECTION 000110
TABLE OF CONTENTS

PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

000101 - Project Title Page

000105 - Certifications Page

000110 - Table of Contents

SPECIFICATIONS

DIVISION 01 -- GENERAL REQUIREMENTS

015639 - Temporary Tree and Plant Protection

015713 - Temporary Erosion and Sediment Control

DIVISION 02 -- EXISTING CONDITIONS

024100 - Demolition

DIVISION 03 -- CONCRETE

032000 - Concrete Reinforcing

033000 - Cast-in-Place Concrete

DIVISION 04 -- MASONRY

DIVISION 05 -- METALS

DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

DIVISION 08 -- OPENINGS (NOT USED)

DIVISION 09 -- FINISHES

099620 -- Permanent Non-Sacraficial Anti-Graffiti Coating

DIVISION 10 -- SPECIALTIES

DIVISION 11 -- EQUIPMENT

116833 - Athletic Field Equipment

DIVISION 12 -- FURNISHINGS

DIVISION 13 -- SPECIAL CONSTRUCTION

DIVISION 14 -- CONVEYING EQUIPMENT

DIVISION 21 -- FIRE SUPPRESSION

DIVISION 22 -- PLUMBING

DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC) (NOT USED)

DIVISION 25 -- INTEGRATED AUTOMATION (NOT USED)

DIVISION 26 -- ELECTRICAL

- 260505 - Selective Demolition for Electrical
- 260519 - Low-Voltage Electrical Power Conductors and Cables
- 260526 - Grounding and Bonding for Electrical Systems
- 260529 - Hangers and Supports for Electrical Systems
- 260533.13 - Conduit for Electrical Systems
- 260533.16 - Boxes for Electrical Systems
- 260548 - Vibration and Seismic Controls for Electrical Systems
- 260553 - Identification for Electrical Systems
- 260573 - Power System Studies
- 260583 - Wiring Connections
- 260923 - Lighting Control Devices
- 262100 - Low-Voltage Electrical Service Entrance
- 262413 - Switchboards
- 262713 - Electricity Metering
- 262813 - Fuses
- 262816.16 - Enclosed Switches
- 264300 - Surge Protective Devices
- 265600 - Exterior Lighting

DIVISION 27 -- COMMUNICATIONS

- 270000 - Communication Administration
- 271300 - Communication Backbone Cabling

DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

- 284600 - Fire Detection and Alarm

DIVISION 31 -- EARTHWORK

- 311000 - Site Clearing

312200 - Grading
312316 - Excavation
312316.13 - Trenching
312323 - Fill

DIVISION 32 -- EXTERIOR IMPROVEMENTS

320190 - Landscape Maintenance
321120 - Subbase and Aggregate Base Courses
321216 - Asphalt Paving
321313 -- Concrete Paving
321373 -- Pavement Joint Sealers
321723 - Painted Pavement Markings
321740 - Streetbond SB150 (Flat Surface)
323125 -- Ameristar Montage II
323113 - Chain Link Fences and Gates
323300 - Site Furnishings
323314 - Site Bicycle Lockers
323353 - Architectural Site Concrete
328423 -- Irrigation
329119 - Landscape Grading
329300 - Landscape Work

DIVISION 33 -- UTILITIES

331416 - Site Water Utility Distribution Piping
333113 - Site Sanitary Sewerage Gravity Piping
334211 - Stormwater Gravity Piping

DIVISION 34 -- TRANSPORTATION (NOT USED)

DIVISION 35 -- WATERWAY AND MARINE CONSTRUCTION (NOT USED)

DIVISION 40 -- PROCESS INTEGRATION (NOT USED)

DIVISION 42 -- PROCESS HEATING, COOLING, AND DRYING EQUIPMENT (NOT USED)

DIVISION 44 -- POLLUTION CONTROL EQUIPMENT (NOT USED)

DIVISION 46 -- WATER AND WASTEWATER EQUIPMENT (NOT USED)

END OF SECTION

SECTION 015639
TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Tree protection of existing trees and plants

B. Tree pruning of existing trees

1.02 RELATED REQUIREMENTS

A. Section 311000 - Site Clearing.

B. Section 329300 - Landscape Work.

1.03 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:
   1. Organic Mulch: 1-pint (0.5-L) 1-quart (1-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
   2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
   3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
   1. Species and size of tree.
   2. Location on site plan. Include unique identifier for each.
   3. Reason for pruning.
   4. Description of pruning to be performed.
   5. Description of maintenance following pruning.

D. Qualification Data: For qualified arborist and tree service firm.

E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.05 QUALITY ASSURANCE

A. Arborist Qualifications:
   1. Certified Arborist as certified by ISA.
   2. Licensed Arborist in jurisdiction where Project is located.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
      a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
      b. Enforcing requirements for protection zones.
      c. Arborist's responsibilities.
      d. Contractor responsibilities
      e. Field quality control.

1.06 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or trenching or digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
   8. Do not direct vehicle or equipment exhaust toward protection zones.
   9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) Insert dimension in diameter; and free of weeds, roots, and toxic and other nonsoil materials.

1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.
2. Refer to Section 32 Landscape Work for material requirements.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
1. Type: Wood and bark chips.
2. Size Range: 1-1/2" inch minimum, 3" maximum.
3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Architect.
1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
a. Height: 6 feet (1.8 m).
b. Galvanized
c. Polymer-Coating Color: Black.
2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm) .

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size: as required
2. Text: "TREE PROTECTION ZONE - KEEP OUT. No unauthorized entry. No storage of vehicles, materials, or debris. No dumping of chemicals, slurry, paint, oil, etc. "
3. Lettering: 3-inch (75-mm-)high minimum, black characters on white background.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.02 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag - Tie a 1-inch (25-mm) blue-vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
1. Apply 3-inch (76-mm) average thickness of organic mulch. Do not place mulch within 6 inches (152 mm) of tree trunks.

3.03 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
   1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
   2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
   3. Access Gates: Install as required; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet (10.5 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
   2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.04 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only roots smaller than 2” in diameter that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.05 ROOT PRUNING

A. Do Not prune any roots without written authorization from Arborist or Client.

B. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
   1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
   2. Cut Ends: Do not paint cut root ends. Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with emulsified asphalt or other coating formulated for use on damaged plant tissues as approved by the arborist.
   3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   4. Cover exposed roots with burlap and water regularly.
   5. Backfill as soon as possible according to requirements in Division 31 Section "Grading"

C. Root Pruning at Edge of Protection Zone: Prune roots 12 inches (300 mm) outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

D. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.06 CROWN PRUNING

A. Do not prune any branches without written authorization from Arborist or Client.

B. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
   1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
   2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
      a. Type of Pruning: Cleaning Thinning Raising Reduction.
   3. Cut branches with sharp pruning instruments; do not break or chop.
   4. Do not apply pruning paint to wounds.

C. Chip removed branches and dispose of off-site.

3.07 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
   1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 4 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.08 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.09 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
   1. Submit details of proposed root cutting and tree and shrub repairs.
   2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
   3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
   4. Perform repairs within 24 hours.
   5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
   1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches (100 mm) or smaller in caliper size.
   2. Provide one new tree(s) of 6-inch (150-mm) caliper size for each tree being replaced that measure more than 4 inches (100 mm) in caliper size.
      a. Species: Species selected by Architect.
   3. Plant and maintain new trees as specified in Division 32 Section "Landscape Work"

C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) O.C. Backfill holes with an equal mix of native soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 015713
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 311000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.

B. Section 312200 - Grading: Temporary and permanent grade changes for erosion control.

1.03 REFERENCE STANDARDS

A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.

B. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).

C. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).

D. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.

E. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).

F. California State Water Resources Control Board, Construction General Permit; current edition.

G. California Stormwater Quality Association (CASQA), California Stormwater Best Management Practice (BMP) Handbook; current edition.

H. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

1.04 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of State Water Resources Control Board for erosion and sedimentation control .

B. Best Management Practices Standard: CASQA Stormwater BMP Handbook, latest edition.

C. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

1. Owner will obtain permits and pay for securities required by authority having jurisdiction.

2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.

D. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

E. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.

F. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
1. Control movement of sediment and soil from temporary stockpiles of soil.
2. Prevent development of ruts due to equipment and vehicular traffic.
3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

G. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
1. Prevent windblown soil from leaving the project site.
2. Prevent tracking of mud onto public roads outside site.
3. Prevent mud and sediment from flowing onto sidewalks and pavements.
4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

H. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

I. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

J. Open Water: Prevent standing water that could become stagnant.

K. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide materials in conformance with the California Stormwater Quality Association Best Management Practices (BMP) fact sheets for Construction.

B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. The project SWPPP shall be prepared and electronically uploaded to the State Water Board's SMARTS system database by the Owner's Qualified SWPPP Developer (QSD), the Owner's Approved Signatory (AS), or as by a data submitter as designated by the Owner.

B. The Contractor shall employ the services of a Qualified SWPPP Practitioner (QSP). The QSP shall download copies of the approved SWPPP from SMARTS, and is responsible for imnplementation and enforcement of the SWPPP and erosion control plans. At least one (1) copy of the SWPPP shall be available on the site at all times.

C. The QSP is responsible for training of personnel for proper implementation of the SWPPP, monitoring, and all required reports.

D. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 MAINTENANCE

A. Inspect preventive measures as required by the Storm Water Pollution Prevention Plan (SWPPP).

B. Repair deficiencies immediately.

C. Clean out temporary sediment control structures and relocate soil on site.

D. Place sediment in appropriate locations on site; do not remove from site.

3.04 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

3.05 SWPPP CLOSEOUT

A. Within 90 days of construction completion, the QSP shall electronically file a Notice of Termination (NOT) in the Stormwater Multiple Application and Report Tracking System (SMARTS) online.

B. The QSP shall provide a Final Site Map for inclusion with the NOT. The Final Site Map shall provide sufficient information, including photos, to demonstrate compliance with the Permit regarding final site stabilization. All photo locations and directions sall be identified on the Final Site Map. All photos shall clearly labeled.

C. The QSP is reponsible for filing the annual report.

END OF SECTION

SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of built site elements.

B. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

C. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

D. Section 01 50 13 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.03 DEFINITIONS

A. Demolish: Dismantle, raze, destroy, or wreck any building or structure or any part thereof.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Site Plan: Indicate:
   1. Vegetation to be protected.
   2. Areas for temporary construction and field offices.
   3. Areas for temporary and permanent placement of removed materials.

C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.

1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
2. Summary of safety procedures.
3. Demolition firm qualifications.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 DEMOLITION

A. Remove paving and curbs required to accomplish new work.

B. Remove portions of concrete slabs on grade as indicated on drawings.

C. Remove other items indicated, for salvage, relocation, and recycling.

D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with requirements in Section 01 7000 - Execution and Closeout Requirements.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
1. Obtain required permits.
2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
3. Provide, erect, and maintain temporary barriers and security devices.
4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
5. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
6. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Do not begin removal until built elements to be salvaged or relocated have been removed.

E. Protect existing structures and other elements to remain in place and not removed.
1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

C. Remove existing work as indicated and required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
   2. Remove items indicated on drawings.

D. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

E. Protect existing work to remain.
   1. Prevent movement of structure. Provide shoring and bracing as required.
   2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch to match new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Comply with Section 01 50 13 - Construction Waste Management and Disposal.

B. Remove debris, junk, and trash from site.
C. Remove materials not to be reused on site.
D. Leave site in clean condition, ready for subsequent work.
E. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 032000
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

C. Reinforcing steel for masonry work.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed, then the most current version of the standard shall be used or as referenced by other standards.
   1. ACI 301 - Specifications for Concrete Construction.
   2. ACI 315 – Details and Detailing of Concrete Reinforcement.
   3. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
   4. ACI MNL-66 - ACI Detailing Manual.
   5. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
   6. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   7. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
   8. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
   9. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   10. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination
   11. AWS A5.1 – Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
   12. AWS A5.5 – Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
   13. AWS D1.1/D1.1M – Structural Welding Code – Steel.
   14. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars.
   15. AWS D1.8/D1.8M - Structural Welding Code - Seismic Supplement.
   16. CRSI (DA4) - Manual of Standard Practice.
   17. CRSI (P1) - Placing Reinforcing Bars.

B. California Code of Regulations (CCR):
   1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
      a. Chapter 17A - Structural Tests and Inspections
      b. Chapter 19A - Concrete
   2. CBSC, Title 24, Part 11 - California Green Building Standards Code (CALGreen)
      a. Supplement 1, July 2024

C. US Army Corps of Engineers (USACE)
   1. CW03210: Civil Works Construction Guide Specifications for Steel Bars, Welded Wire Fabric and Accessories for Concrete Reinforcement

D. United States Green Building Council (USGBC):
   1. Leadership in Energy and Environmental Design (LEED):
   2. Green Building Rating System.

1.04 GENERAL

A. Coordination: Refer to Section 01 50 13 - Construction Waste Management and Disposal regarding procedures for implementing construction waste management requirements.

B. Coordination: Coordinate Work specified in this Section with other Sections which require placement of embedded products and provision of openings and recesses. If formwork is placed after reinforcing, resulting in insufficient concrete cover over reinforcing, request instructions from Architect (Structural Engineer) before proceeding.

C. Refer to Section 013000 - Administrative Requirements for RFI requirements.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Reinforcing Shop Drawings:
   1. Prepare Shop Drawings in accordance with the applicable requirements of ACI 318 and the CRSI Manual.
   2. Provided scaled, dimensioned reinforcing plans for each floor level indicating size and spacing of reinforcing. Coordinate additional bars with locations of slab openings, penetrations, depressions and steps. Shop drawing shall be coordinated with concrete shop drawings. Ensure penetrations from affected trades for utilites are coordinated.
   3. Provide scaled, dimensioned reinforcing elevations for each wall line indicating size and spacing of reinforcing. Coordinate additional bars with locations of openings, penetrations, and recesses. Shop drawing shall be coordinated with concrete shop drawings. Ensure penetrations from affected trades for utilites are coordinated.
   4. Indicate welds in accordance with AWS D1.4/D1.4M and AWS A2.4.
   5. Indicate type of corrosion resistant reinforcing proposed and locations, if applicable.
   6. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

C. Test Reports: Submit certified laboratory test reports confirming physical characteristics of materials used in the performance of the work of this Section.
   1. Where reinforcing is subject to welding, submit carbon equivalent determination reports in accordance with requirements of Source Quality Control.

D. Certificates: Submit copies of steel producer's certificates of mill analysis, tensile, and bend tests for reinforcing steel. Transmit copy to installer for welded splices.

E. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

F. Sustainable Design Submittals:
   1. Type III factory-specific or product-specific environmental product declarations (EPD) for each grade of reinforcement proposed for the project.

1.06 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 318, ACI 301, CRSI and CBC Chapter 19A.

B. Fabricator's Qualifications:

1. When required, show evidence of approval by governmental agencies having jurisdiction.

C. Welding of reinforcing shall be in conformance with AWS D1.1/D1.1M, AWS D1.4/D1.4M, AWS D1.8/D1.8M, and CBC Chapter 19.

D. Qualification of Welds, Welding operators, and welders:
   1. Comply with applicable building code standard. Perform welding procedure qualification, except for prequalified procedures, as required by AWS D1.4/D1.4M, prior to executing any welding of reinforcing steel.
   2. Only AWS Certified Welding Inspectors shall be used for tests and qualifications associated with welding of reinforcing steel.
   3. Only AWS qualified welders or welding operators shall perform welding of reinfocing steel.
   4. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months and in accordance with AWS D1.4/D1.4M.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage. Deliver reinforcing materials bundled and with identifying labels or tags affixed and legible.
   1. Bundle reinforcing, tag with identification, and transport and store so as not to damage any material. Use metal tags indicating size, length and other marking shown on placement drawings. Maintain tags after bundles are broken.

B. The Inspector and/or Architect reserves the right to observe deliveries, to review bills of lading, and to reject the following:
   1. Reinforcing not accompanied by required mill certificates.
   2. Reinforcing exhibiting rusting or other contamination which might prohibit or inhibit bonding of concrete.

C. Store materials off ground and under cover.
   1. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
   2. Store welding electrodes in accordance with AWS standards.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Provide deformed-type reinforcing conforming to ASTM Standards and material Grades.
   1. Rebar shall conform to ASTM A706 Grade 60 or ASTM A615 Grade 60. ASTM A615 Grade 60 requires 80,000psi minimum tensile strength with 1.10 minimum ratio of actual tensile strength to actual yield strength based on mill testing.

B. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064/A1064M.
   1. Form: Flat Sheets.
   2. WWR Style: As indicated on drawings.

C. Global Warming Potential (GWP) Limit: as indicated on the drawings.

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch, conforming to ASTM A1064/A1064M , Grade 60.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 FABRICATION

A. Do not fabricate reinforcing until shop drawings have been reviewed by Architect.

B. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice, ACI MNL-66: Detailing Manual, and ACI 318.

C. In case of fabrication errors, do not rebend or straighten reinforcing in a manner that will injure or weaken the material.

D. Do not heat reinforcing to faciliate bending.

E. Welding of reinforcement is permitted only where shown on drawings using ASTM A706 reinforcing. Perform welding in accordance with AWS D1.4/D1.4M.
   1. Protect joints from drafts during cooling process. Accelerated cooling is prohibited.
   2. Do not tack weld reinforcing.
   3. Fusion welding is not permitted unless approved by Engineer of Record.

F. Locate reinforcing splices not indicated on drawings at point of minimum stress.

G. Comply with tolerances per ACI 117 and CRSI Manual.

H. Reinforcing with any of the following defects will not be permitted:
   1. Lengths, depths, and bends not conforming to the spcified fabrication tolerances.
   2. Bends or kinks not indicated in the drawings.
   3. Reinforcing with reduced cross-section due to excessive rusting or other causes.

2.03 SOURCE QUALITY CONTROL

A. Tests: Materials for which physical characteristics have been stipulated shall have had such characteristics independently confirmed by laboratory tests employing industry recognized procedures.

B. Reinforcing to be welded:
   1. Submit a copy of the mill test report to the Architect prior to placement of reinforcing steel in concrete members.
   2. If mill test reports are not available, perform a chemical analysis of reinforcing representative of the reinforcing to be welded. The carbon equivalent (CE) shall not exceed 0.55.
   3. Special inspection is required for welding of steel reinforcing.

C. Source Quality Control: Testing Laboratory shall test samples of reinforcing, ties, and stirrups from the material at the site or from place of distribution. Each sampling shall include at least two 18-inch long pieces. Perform the following tests according to ASTM A615:
   1. Identified Reinforcing: Samples shall be obtained from bundles delivered from the mill, identified by heat number and accompanied by mill analyses and mill test reports. Reinforcing shall be properly tagged with Identification Certificate so as to be readily identified. Then perform one tensile and one bend test for each 10 tons or fraction thereof of each size of reinforcing per CBC Section 1909.2.4. Submit mill reports when samples are selected.
   2. Unidentified reinforcing is not permitted.
   3. Refer to Section 014000 - Quality Requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean reinforcing to remove loose rust and mill scale, earth, and other materials which might reduce or destroy bond with concrete.

3.02 PLACEMENT

A. General: Comply with the CRSI Manual of Standard Practice and CRSI Placing Reinforcing Bars, 10th edition, for details and methods of placing reinforcing and supports.
   1. Do not displace or damage vapor barrier while placing concrete reinforcing. If damage occurs, repair vapor barrier before placing concrete.
      a. Provide for movement which equals joint width plus 1/2-inch.
   2. Expansion Joints in Slab-on-grade: Interrupt reinforcing at expansion joints. Provide No. 5 by 24-inch long dowelled joints at 18 inches on centers with one end of dowel set in capped dowel sleeve.
   3. Construction Joints: Allow reinforcing to run through without interruption, unless otherwise noted on Contract Structural Drawings.

B. Support: Position, support, and secure reinforcing against displacement by formwork, construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as required and as indicated on Contract Drawings.
   1. Provide sufficient numbers and sizes of supports to carry reinforcing.
      a. Do not place reinforcing more than 2 inches beyond the last leg of any continuous reinforcing support.
      b. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
      c. Provide additional reinforcing for support where required to support reinforcing shown on Contract Drawings.
   2. Repair and resupport reinforcing which may have moved during concrete placement operations.

C. Securing in Place:
   1. Accurately place reinforcing and wire tie in precise position where reinforcing cross. Bend ends of wire ties away from the forms. Wire tie reinforcing to corners of ties and stirrups.
   2. Support reinforcing according to the current edition of CSRI Recommended Practice for Placing Reinforcing Supports using approved accessories and chairs.
   3. Place precast concrete cubes with embedded wire ties to support reinforcing steel in concrete placed on grade and in footings. Precast concrete cubes are not acceptable in elevated concrete slabs, beams, or concrete filled metal deck.
   4. Use care not to damage vapor barriers where they occur.
   5. Dowel Bar Couplers:
      a. Attach flanged, internally threaded end of dowel bar coupler to inside of formwork, using nails or screws.

D. Coverage: Place reinforcing to obtain minimum coverages for concrete protection in accordance with ACI 318 Chapter 20.5.1.3, or as indicated on Contract Structural Drawings. Securely tie reinforcing and related supports together with tie wire to hold reinforcing accurately in position during concrete placement operations. Place wire ties so that twisted ends are directly away from exposed concrete surfaces.

E. Clearance Between Reinforcing: Per ACI 318 and as indicated on Contract Drawings.

F. Splicing:
   1. Provide standard reinforcing splices by lapping ends and tying securely with tie wire. Comply with details indicated on Contract Structural Drawings.
      a. Unless noted otherwise on Contract Drawings, comply with requirements of ACI 318 for minimum lap of Class B spliced reinforcing, including ACI 318 as amended by CBC.
   2. Provide 1-1/2-inch minimum clearance between sets of splices. Stagger horizontal reinforcing so that adjacent splices are greater than 4 feet apart, unless noted otherwise on Structural Contract Drawings.

3. Field Welding: Comply with the requirements of AWS D1.4 where field welding is required. Prior to field welding, determine the weldability of reinforcing in accordance with section "Source Quality Control" in Part 2. Only steel conforming to the chemical requirements of AWS D1.4 may be welded.
4. Splices: Do not splice reinforcing at the points of maximum stress except where indicated. Lap splices as shown or required to develop the full strength of reinforcing. Stagger splices in horizontal wall reinforcing at least 24" longitudinally in alternate reinforcing and opposite faces.

G. Wire Fabric: Install welded wire fabric in longest lengths practicable. Lap adjoining pieces at least 12 inches minimum, and lace splices with tie wire. Offset end laps in adjacent widths to prevent continuous laps.
1. Extend fabric to within 1 inch of edge at slabs.

H. Slab on Grade Reinforcing: Do not displace or damage vapor retarder at slab on grade.

I. Dowels: Secure tie dowels in place before depositing concrete. Provide No. 3 reinforcing for securing dowels where no other reinforcing is provided

J. Maintaining Reinforcing in Position: Provide adequate means to ensure that reinforcing position and spacing is maintained during placement of concrete.

K. Adjustment and Inspection: Do not bend or straighten reinforcing in a manner injurious to material. Do not use reinforcing with kinks or bends not shown on Drawings and reviewed shop drawings or reinforcing with reduced cross-section due to corrosion or other cause.

L. Tolerances: Placement tolerances shall conform to CRSI Manual of Standard Practice and ACI 117.

3.03 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 014000 - Quality Requirements, will inspect installed reinforcement for conformance to contract documents before concrete placement.

B. Inspection and Tests of Welds: Provide special inspection of shop and field welding in accordance with CBC Section 1704A, 1705A, 1903A, and Structural Contract Drawings.
1. Tests will be made by testing laboratory for reinforcing welds, as follows:
a. Qualification of welders engaged in electric-arc welding of reinforcing.
b. Verification of location of reinforcing for accuracy.
c. Inspection of reinforcing welds by certified welding inspectors.
d. X-ray test of one of the first three arc-welds made by each welder.
2. Tensile tests of sample welds of the largest size reinforcing for each type of welding.
3. When welds are judged to be deficient, provide and pay for such additional X-rays and tests as directed by the Architect. Defective welds shall be repaired, replaced, and retested.

C. Placing: Provide special inspection as required by CBC 1705A.
1. Placement of Grade 60 or higher reinforcing steel for concrete above grade requires special inspection.
2. Schedule inspecting of reinforcing steel for conduit, sleeves, and embedded items to allow for correction, if necessary, before placement of overlying grids on reinforcing steel.

3.04 ADJUSTING

A. Defective Reinforcing Work: The following shall be considered defective and may be ordered removed and reconstructed at no change in Contract Time or Contract Sum:
1. Reinforcing with kinks or bends not shown on Contract Drawings.
2. Reinforcing injured due to bending or straightening.

3. Reinforcing heated or bent.
4. Reinforcing not placed in accordance with Contract Documents.
5. Reinforcing that is rusty or oily.
6. Reinforcing exposed in surface of concrete

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Joint devices associated with concrete work.

B. Site Concrete Elements, including, but not limited to freestanding walls and their foundations, retaining walls and their foundations, light pole bases and their foundations, flagpole bases and their foundations, and equipment pad.

C. Miscellaneous concrete elements, including equipment pads and equipment pits.

D. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 014113.11 - Regulatory Requirements - Global Warming Potential (GWP)

B. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.

C. Section 032000 - Concrete Reinforcing.

D. Section 079200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

E. Section 323353 - Architectural Site Concrete for additional requirements for retaining walls and other site concrete.

1.03 REFERENCE STANDARDS

A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed, then the most current version of the standard shall be used or as referenced by other standards.
   1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
   2. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide.
   3. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
   4. ACI 232.2R – Report on the Use of Fly Ash in Concrete
   5. ACI 233R – Guide to the Use of Slag Cement in Concrete
   6. ACI 234R – Guide for the Use of Silica Fume in Concrete
   7. ACI 301 - Specifications for Concrete Construction.
   8. ACI 302.1R - Guide to Concrete Floor and Slab Construction.
   9. ACI 303R – Guide to Cast-in-Place Architectural Concrete Practice
   10. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
   11. ACI 305R - Guide to Hot Weather Concreting.
   12. ACI 306R - Guide to Cold Weather Concreting.
   13. ACI 308R - Guide to External Curing of Concrete.
   14. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
   15. ACI 347R - Guide to Formwork for Concrete.
   16. ACI 360R – Guide to Design of Slabs-on-Ground
   17. ACI 503.4 – Standard Specification for Repairing Concrete with Epoxy Mortars

18. ACI MNL-15 – Field Reference Manual
19. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
20. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
21. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
22. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
23. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
24. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens).
25. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
26. ASTM C150/C150M - Standard Specification for Portland Cement.
27. ASTM C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
28. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
29. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete.
30. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
31. ASTM C231/C231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
32. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.
33. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
34. ASTM C295/C295M - Standard Guide for Petrographic Examination of Aggregates for Concrete.
35. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
36. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete.
37. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
38. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
39. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements.
40. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
41. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
42. ASTM C755 - Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
43. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
44. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars.
45. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
46. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
47. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
48. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
49. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

50. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
51. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
52. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
53. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
54. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
55. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
56. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
57. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
58. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
59. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
60. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

B. California Code of Regulations (CCR):
   1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
      a. Chapter 11b - Accessibility to Public Buildings, Public Accommodations, Commercial Buildings, and Public Housing:
         1) Division 3 - Building Blocks.
            (a) Section 11B-302 - Floor or Ground Surfaces.
         2) Division 4 - Accessible Routes.
            (a) Section 11B-403 - Walking Surfaces.
      b. Chapter 17 - Structural Tests and Inspections.
      c. Chapter 19 - Concrete.
   2. CBSC, Title 24, Part 11 - California Green Building Standards Code (CALGreen), 2022 edition.
      a. Supplement 1, July 2024

C. US Army Corps of Engineers (USACE)
   1. COE CRD-C 513 - Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops 1974.

D. ICC Evaluation Service, Inc. (ICC ES), a subsidiary corporation of the International Code Council:
   1. ICC ES Evaluation Reports (ESR) for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.

E. International Association of Plumbing and Mechanical Officials (IAPMO):
   1. IAPMO Uniform Evaluation Service (UES) Report for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.

F. Public Works Standards, Inc. (PWS):
   1. Standard Specifications for Public Works Construction, (Greenbook), latest edition with amendments, published by BNi Building News.

1.04 GENERAL

A. Identify finish flooring manufacturers' concrete slab vapor emission and alkalinity requirements and coordinate concrete slab mixing and installation procedures to achieve desired results. Concrete slab requirements for finish flooring may be more restrictive than general requirements of the Contract Documents, and may require additional materials, means, or methods. Additional materials, means, or methods shall be included as part of the work.

B. Coordinate method of securing reinforcing and other embedded items in concrete slabs on grade without penetrating vapor barriers.

C. Verify depth of slab depressions for waterproofing and toppings at walking decks.

D. Verify depth of slab depression for frame and pan of entrance floor grilles. Coordinate leveling of floor with floor leveling compound and embedment of frame.

1.05 DEFINITIONS

A. Embodied Carbon Footprint: Embodied carbon is the carbon dioxide equivalent (CO2e) footprint of the Project before it becomes operational. Embodied carbon is expressed as Global Warming Potential (GWP).

B. Global Warming Potential: Global Warming Potential (GWP) is the heat absorbed by any greenhouse gas in the atmosphere as a multiple of the heat that would be absorbed by the same mass of carbon dioxide. GWP is 1 for CO2. GWP for reinforcing is expressed as kg of CO2e per metric ton of fabricated steel reinforcing.

C. Environmental Product Declaration: An Environmental Product Declaration (EPD) quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. EPDs are conducted in accordance with a Product Category Rule for the specific product being evaluated.

D. Product Category Rule: Product Category Rules (PCR) are a set of rules, requirements, and guidelines for developing Environmental Product Declarations (EPD) for one or more categories.

E. Life Cycle Assessment: Life Cycle Assessment (LCA) is a methodology for assessing environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions, along with agency approvals (ICC, IAPMO, etc.) where applicable.

C. Mix Design: Submit proposed concrete mix design for approval.

1. Submit design mix data for each type of concrete and each compressive strength required on the Contract Drawings. Submittal of mix designs shall not relieve Contractor of its responsibility to furnish concrete of proper consistency and specified strengths. Where used for concrete subject to special inspections, submit mix designs to testing laboratory for review and written acceptance.
    a. Indicate proposed mix design complies with requirements of ACI 301, Section 4 and ACI 318 26.4.3.
    b. Design mix submittal shall be stamped and signed by a professional engineer licensed in the State of California.
    c. For each material, including admixtures and water, state water-cement ratio and maximum allowable water content.
    d. For each material, state manufacturer's name, designation, and source.

e. Submit shrinkage and creep factors for each type of aggregate, and each source proposed for use, for acceptance-review.
f. For each mix design:
1) Pay costs associated with mix design preparation.
2) Consider concrete cover and clear distances between reinforcing bars as indicated on the Contract Drawings in determining the aggregate size for mix designs. This may result in an aggregate size smaller than specified elsewhere in this Specification.
3) Submit a schedule which identifies the locations within the structure where each mix design is proposed for use.
4) Submit project specific 28-day shrinkage test results in accordance with shrinkage test requirements in Part 2 "CONCRETE MIX DESIGN."
5) Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.

D. Shop Drawings. Concrete shop drawings shall be coordinated with shop drawings requirements for reinforcement and formwork. Submit the following items for review:
1. Layout drawings showing locations of slab-on-grade joints.
2. Scaled, dimensioned plans for each floor level indicating size and location of slab openings, penetrations, depressions, and steps. Shop drawing shall be coordinated with reinforcing shop drawings. Ensure penetrations from affected trades for utilities are coordinated.
a. Provided review stamp, with signature and date, of each trade proposed to work within the opening or penetration.
3. Proposed Construction Joints.
4. Scaled, dimensioned concrete elevations for each wall line indicating size and location of openings, penetrations, and recesses. Shop drawing shall be coordinated with reinforcing shop drawings. Ensure penetrations from affected trades for utilities are coordinated.
a. Provided review stamp, with signature and date, of each trade proposed to work within the opening or penetration.

E. Concrete Placement Schedule: Submit the proposed concrete placement schedule to the Architect for review prior to start of concrete placement.

F. Samples:
1. Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
2. Submit samples of underslab vapor retarder to be used.
3. Submit two, 12 inch long samples of waterstops and construction joint devices.
4. Aggregate proposed for exposed finish, indicating color, texture, and size, for acceptance-review. Submit not less than 1 pound of aggregate.

G. Test Reports: Submit report for each test or series of tests specified.
1. Submit certified laboratory test reports to Architect and, when applicable, the authority having jurisdiction, confirming physical characteristics of materials used.
2. Shrinkage and petrographic tests on concrete with the proposed aggregate.

H. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
2. Aggregates and sand.
3. Admixtures.
4. Fiber reinforcement.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.

9. Vapor retarders.
10. Semi-rigid joint filler.
11. Joint-filler strips.
12. Repair materials.

I. Sustainable Design Submittals:
1. Embodied Carbon Footprint Submittals
a. Plant-specific Environmental Product Declaration (EPD) for each concrete mixture proposed for the project accompanying each concrete mixture submittal.
b. A calculation showing that the Global Warming Potential (GWP) of all the concrete supplied for the project shall be lower than the GWP target set in Section 2.

J. Project Record Documents:
1. Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
2. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
3. Concrete Placement: Date and time of each placement as provided in the placement schedule. Include start and end times, temperatures, humidities, and wind velocities.
4. Test Cylinders: Cross-reference to placement record entries

1.07 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with ICC (IBC) Chapter 19.
1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.

B. Perform work of this section in accordance with ACI 301 and ACI 318.
1. Maintain one copy of each document on site.

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

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

E. Installer Qualifications: A qualified installer who employs on the Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

F. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer shall be certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities." The certificate shall indicate that the plant has automatic batching and recording capabilities such that requirements of CBC 1705.3.3.1 are met.

G. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

H. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

I. Pre-installation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.
   e. Special concrete finish subcontractor.
2. As applicable to the Work, review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures and concrete protection.

J. Mock-up
1. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish as result of formwork.
   a. Panel Size: Sufficient to illustrate full range of treatment.
2. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.
3. Mock-up may not remain as part of the Work.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

C. Warrant concrete floor sealer to be free from manufacturing defects for a period of 15 years. Applications completed by an approved installer in accordance with published technical data will be warranted for the suppression and control of water vapor emission, alkalinity, and relative humidity from concrete during the warranty period.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of ASTM C595/C595M for packaging and marking for cement delivery.

PART 2 PRODUCTS

2.01 GENERAL

A. Regulations: Refer to Section 014533 regarding compliance with applicable codes and regulations.

B. Comply with ACI 301 and ACI 318 for interpreting design requirements of reinforced concrete.
1. Contractor shall keep a copy of ACI Field Reference Manual MNL-15(16) in the field office.

C. Comply with, regulations of the air quality management district in force at the time of the performance of the work of this Section regarding sealers and curing compounds.

D. Finish concrete surfaces shall be stable, firm, and in compliance with CBC Section 11B-403 requirements for slip resistance.

1. Concrete paving shall have a minimum slip resistance coefficient of friction of 0.6 as tested in accordance with ASTM D2047.
2. Refer to Part 3 for non-slip finish procedures at exterior concrete platforms, steps, and ramps.

E. Sloping Floors:
1. The running slope of walking surfaces shall not be steeper than 1:20.
2. The cross slope of walking surfaces shall not be steeper than 1:48.
3. At plazas where there is no dominant direction of travel, and at turns, slope shall not exceed 1:48 in any direction.

2.02 FORMWORK

A. Comply with requirements of Section 031000.

2.03 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 032000.

2.04 CONCRETE MATERIALS

A. Hydraulic Cement: Type as indicated on drawings
1. Acquire cement for the entire project from the same source
2. Color: Standard Gray UNO.

B. Normal Weight Aggregates: ASTM C33/C33M and CBC 1909.2.1.
1. Aggregate shall be nonreactive as determined by one of the methods in ASTM C33/C33M Appendix XI: Methods for Evaluating Potential for Deleterious Expansion Due to Alkali Reactivity of an Aggregate.
2. Fine Aggregate: Washed natural sand consisting of hard particles, containing not more than the maximum limits of deleterious material allowed by Table 1 of ASTM C33/C33M.
   a. Fineness modulus shall be in the range of 2.90 to 3.10.
3. Coarse Aggregate, Structural Concrete:
   a. Clean washed gravel or sound crushed rock, containing not more than 5 percent flat, thin, elongated, or laminated material, and containing not more than the maximum limits of deleterious material allowed by Table 3 of ASTM C33/C33M for moderate weathering regions.
      1) Grade 1-inch aggregate from No. 100 sieve to 1 inch.
      2) Grade 1-1/2-inch aggregate from No. 100 sieve to 1-1/2 inches.
   b. Maximum Size: As indicated on drawings and as noted below.
      1) Aggregate shall be no larger than:
         (a) 3/4 of the clear space between reinforcing bars or between reinforcing bars and forms
         (b) 1/5 of the narrowest dimension between sides of forms
         (c) 1/3 of the depth of slab.
      2) 3/8" aggregate may be utilized at areas of congestion only when submitted for review, indicating specifically where intended use will be, and approved by the architect.
      3) Pea Gravel shall not be used.
4. Acquire aggregates for entire project from same source.

C. Lightweight Aggregate: ASTM C330/C330M.
1. Provide lightweight aggregates having a loss of not more than 8 percent when tested by sodium sulfate solution and a loss of not more than 10 percent when tested by magnesium sulfate solution in accordance with ASTM C 88

2. Maximum Size: 3/4 in or as noted below.
    a. Aggregate shall be no larger than:
        1) 3/4 of the clear space between reinforcing bars or between reinforcing bars and forms
        2) 1/5 of the narrowest dimension between sides of forms
        3) 1/3 of the depth of slab.

D. Fly Ash: ASTM C618, Class C or F.

E. Slag Cement: ASTM C989/C989M

F. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

G. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.

H. Water: ASTM C1602/C1602M; clean and not detrimental to concrete.

2.05 ADMIXTURES

A. General:
1. Admixtures and additives shall be reviewed by architect prior to use.
2. Admixtures and additives shall be incorporated and tested in accepted combinations and mixes
3. Admixtures containing chlorides will not be permitted.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
1. Manufacturers:
    a. Euclid Chemical Company; PLASTOL 6420: www.euclidchemical.com/#sle.
    b. Master Builders Solutions; MasterRheobuild 1000: www.master-builders-solutions.com/en-us
    c. Substitutions: See Section 016000 - Product Requirements.

D. Water Reducing Admixture: ASTM C494/C494M Type A.
1. Water reduction: Not less than 5%.
2. Increase in compressive strength: Not less than 10% at 28 days.
3. Dry Shrinkage: Less than concrete without admixture at 21 days.
4. Manufacturers:
    a. Euclid Chemical Company; EUCON NW: www.euclidchemical.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

E. Shrinkage Reducing Admixture:
1. ASTM C494/C494M, Type S.
2. Manufacturers:
    a. Euclid Chemical Company; Eucon SRA Floor: www.euclidchemical.com/#sle.
    b. Euclid Chemical Company; Eucon SRA-XT: www.euclidchemical.com/#sle.
    c. Substitutions: See Section 016000 - Product Requirements.

F. Plasticizer: ASTM C494/C494M , Type F

2.06 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Min 15 mils thick, reinforced high density polyethylene sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Water Vapor Permeance: 0.02 Perms maximum, in accordance with ASTM E154/E154M Section 7.
2. Puncture Resistance: 2200 grams minimum, in accordance with ASTM D1709 Method B.
3. Tensile Strength: 45 lbf/in minimum, in accordance with ASTM E154/E154M Section 9, Method ASTM D882.
4. Installation: Comply with ASTM E1643.
5. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
6. Manufacturers: Comply with ASTM C755
   a. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com/#sle.
   b. Stego Industries, LLC: www.stegoindustries.com/#sle.
   c. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): www.wrmeadows.com/#sle.
   d. Substitutions: See Section 016000 - Product Requirements.

B. Subslab Waterproofing (At Floor Slabs Subject to Minor Hydraulic Moisture Pressures): Vapor barrier under slab on grade with hydraulic moisture pressures or wet soils.
   1. Reinforced high density polyethylene (HDPE), mylar geomembrane, or 1/8-inch thick pre-molded membrane having the following minimum properties:
      a. Water Vapor Permeance: 0.005 Perms maximum, in accordance with ASTM E96/E96M.
      b. Water Vapor Barrier Classification: Class A, in accordance with ASTM E1745.
      c. Puncture Resistance: 2400 grams minimum, in accordance with ASTM D1709 Method B.
      d. Tensile Strength: 70 lbf/in minimum, in accordance with ASTM E154/E154M Section 9, Method ASTM D882.
   2. Accessory Products: Provide vapor proofing mastic, pipe boots, and related accessory products recommended by manufacturer of vapor retarder.
   3. Manufacturers: Comply with ASTM C755.
      a. Alumiseal Corporation; Alumiseal Zero Perm Vapor Barrier.
      b. Reef Industries; Griffolyn VAPORguard.
      c. Stego Industries, LLC; Stego Wrap 15-Mil Class A Vapor Barrier.
      d. Substituitions: See Section 016000 - Product Requirements
   4. Seam Tape:
      a. High density reinforced polyethylene vapor retarding seam tape with pressure sensitive adhesive as recommended by manufacturer of vapor retarder/barrier. Minimum 6 inches in width and of a contrasting color.
   5. Non-Shrink Cementitious Grout:
      a. Non-Shrink Grout: Prepackaged, non-metallic, non-gaseous, aggregate grout complying with ASTM C1107/C1107M. Contractor shall select type for each special application as recommended by manufacturer.
      b. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: As indicated on the Contract Drawings.
      c. Flowable Products:
         1) Euclid Chemical Company; NS GROUT: www.euclidchemical.com/#sle.
         2) Five Star Products, Inc; Five Star Fluid Grout 100: www.fivestarproducts.com/#sle.
         3) The QUIKRETE Companies; QUIKRETE® Exterior Use Anchoring Cement: www.quikrete.com/#sle.
         4) Substitutions: See Section 016000 - Product Requirements.
      d. Low-Slump, Dry Pack Products:

1) Euclid Chemical Company; DRY PACK GROUT: www.euclidchemical.com/#sle.
2) Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
3) The QUIKRETE Companies; QUIKRETE® FastSet™ Non-Shrink Grout: www.quikrete.com/#sle.
4) Substitutions: See Section 016000 - Product Requirements.

6. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
   a. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch.
   b. Manufacturers:
      1) Euclid Chemical Company; E3-DEEP POUR: www.euclidchemical.com/#sle.
      2) Five Star Products, Inc; Five Star DP Epoxy Grout: www.fivestarproducts.com/#sle.
      3) Five Star Products, Inc; Five Star HP Epoxy Grout: www.fivestarproducts.com/#sle.
      4) Substitutions: See Section 016000 - Product Requirements.
7. Patching Mortar:
   a. Provide Polymer modified portland cement mortar. Compressive strength shall equal or exceed compressive strength of substrate concrete.
   b. Mortars shall conform to ASTM C928.
   c. Manufacturers:
      1) Horizontal Application:
         (a) Durapatch Industrial, manufactured by L&M Construction Chemicals.
         (b) Embeco R310, manufactured by BASF Admixture Systems.
         (c) ProSpec Vinyl Concrete Patch, as manufactured by Bonsal American.
      2) Vertical and Overhead application: equal to:
         (a) Durapatch VOH, manufactured by L&M Construction Chemicals.
         (b) Emaco R350, manufactured by BASF Admixture Systems.
         (c) ProSpec Vertical Leveling Mortar, as manufactured by Bonsal American.
8. Floor Leveling Compound: Two-part acrylic polymer latex concrete with compressive strength as tested by ASTM C109/C109M equal or greater than substrate concrete compressive strength.
   a. Manfacturers:
      1) Ardex; K-15.
      2) L&M Construction Chemicals; Levelex.
      3) Maxxon Corporation; Level-Right Plus.
      4) Substitutions: See Section 016000 - Product Requirements
9. Floor Patching Materials:
   a. Patching Materials shall match or exceed compressive strength of the substrate concrete.
      1) Interstate Epoxy Patching Compound.
      2) Sakrete Fast Setting Cement Patcher.
      3) ProSpec Floor Patch Pro, manufactured by Bonsal American.
10. Skim Coat: Blended compound of portland cement, graded silica aggregates, and special chemical additives formulated for bonding, smoothing, rubbing, and thin coating concrete surfaces.
    a. Pavecrete manufactured by Lyons Manufacturing or Rapid Set WunderFixx manufactured by CTC Cement.
    b. Bonding Agent: Manufacturer's Type II acrylic bonding agent, when applicable. Do not use PVA Type I bonding agents.

c. Pigment: SGS ColorFlo Liquid iron oxide color pigments, as manufactured by Solomon Colors, or equal, in accordance with ASTM C 979.
d. Admixture: Chromix-L manufactured by L.M. Scofield Products, or equal product manufactured by Davis Colors.

11. Isolation Joint Sealant: Provide polyurethane type compatible with fiber joint filler.

2.07 BONDING AND JOINTING PRODUCTS

A. Chemical Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II. Agent shall be freeze-thaw resistant and suitbable for brush or spray application.
   1. Manufacturers:
      a. Euclid Chemical Company; AKKRO-7T: www.euclidchemical.com/#sle.
      b. Larsen Products Corp.; Weldcrete.
      c. SpecChem, LLC; Strong Bond Acrylic Bonder: www.specchemllc.com/#sle.
      d. W. R. Meadows, Inc; ACRY-LOK-: www.wrmeadows.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.

B. Waterstops: Rubber, complying with COE CRD-C 513.
   1. Configuration: As indicated on drawings.
   2. Size: As indicated on drawings.

C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.

D. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.

2.08 CURING AND SEALING MATERIALS

A. Floor Liquid Curing Compound Type FCC: For use on concrete slabs that will be exposed with separately applied floor sealer finish, or on slabs that will be covered by breathable floor coverings or mortar beds.
   1. Compound shall be a water-based non-staining dissipating, translucent resin, conforming to ASTM C309, Type 1, Class B.
      a. Sodium silicate compounds will not be permitted.
   2. Product shall be compatible with subsequently applied toppings (sealers, hardeners, finishes, or coverings).
   3. Manufacturers:
      a. Euclid Chemical Co,; Kurex Vox.
      b. L&M Construction Chemicals; L&M Cure R.
      c. Sonneborn Building Products; Sonosil.
      d. W.R. Meadows; Sealtight 1100 Clear.
      e. Substitutions: See Section 016000 - Product Requirements

B. Curing Barriers:
   1. Waterproof Curing Paper: Conform to ASTM C171, non-staining reinforced type.
      a. Manufacturer:
         1) Fortifiber Corporation; Orange Label Sisalkraft.
   2. Reinforced Curing Barriers: Transguard 4000 manufactured by Reef Industries or equal.

C. Floor Remedial Vapor Emission and Alkalinity Control Sealer Type FCS: For remedial use on concrete slabs on grade that do not meet manufacturer's specific moisture emission and alkalinity limits for non-breathable floor finishes.
   1. Manufacturers:

a. Sinak Corporation; Sinak VC5: www.sinak.com.
b. Bonsal American; ProSpec Moisture Guard Max.
c. Synthetics International; Synthetic30 two-component liquid-applied, waterborne polymer-based ultra-low viscosity clear sealer. www.syntheticsintl.com.
d. Substitutions: See Section 016000 - Product Requirements

D. Floor Sealer Finish Type FSF: For general use at exposed concrete slab areas for appearance.
1. Design is based on the use of high solids, minimum 25% non-yellowing water-based acrylic cure/sealer conforming to ASTM C309, Type 1, Class B and ASTM C1315, Type 1, Grade B, low VOC compliant meeting all local air quality regulations.
2. Product shall be in compliance with volatile organic compounds (VOC) content limits required by air quality management district at the time of performance of the work.
3. At Exposed Concrete Surfaces at Garage Areas:
a. Compound shall be a water-based non-staining dissipating, translucent resin, conforming to ASTM C309, Type 1, Class B.
4. Sodium silicate compounds will not be permitted.
5. Manufacturers:
a. Euclid Chemical Co.; Euclid Aqua Cure VOX Super.
b. L&M Construction Chemicals; Dress & Seal WB30.
c. W.R. Meadows; VOComp 25.
d. Sinak Corporation; HLQ-125.
e. Substitutions: See Section 016000 - Product Requirements

E. Wall Sealer and Water Repellent Finish Type WSR: For general use at exposed concrete wall surfaces in Restrooms for code compliance.
1. Design is based on the use of a modified neat silane repellent system offering invisible protection and low volatility combined with water and oil repellency on concrete substrates to prevent staining by waterborne and oily substance.
2. Product shall be in compliance with volatile organic compounds (VOC) content limits required by air quality management district at the time of performance of the work.
3. Manufacturers:
a. Miracle Sealants Co.; 511 Impregnator.
b. Prosoco, Inc.; Stand Off SLX100 Water & Oil Repellent.
c. Substitutions: See Section 016000 - Product Requirements.

2.09 CONCRETE MIX DESIGN

A. Global Warming Potential (GWP) Limit: As Indicated, per mix
1. Exception: Concrete may be considered one product category. A weighted average of the maximum GWP for all concrete mixes installed in the project shall be less than the weighted average maximum GWP specified on the structural drawings. Calculation shall be submitted to the Architect (Engineer) for approval

B. Mix design shall be stamped and signed by a professional engineer licensed in the State of California.

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

D. Proportioning Structural Lightweight Concrete: Comply with ACI PRC-213 recommendations.

E. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.

F. Concrete Compressive Strengths: Provide compressive strengths as noted on drawings, when tested in accordance with ASTM C39/C39M at 28 days.

1. Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
    a. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

G. Fly Ash or other pozzolans Content: Maximum 25 percent of cementitious materials by weight.

H. Total of fly ash or natural pozzolans and silica fume: Maximum 35 percent by weight.

I. Total of fly ash or natural pozzolans slag cement and silica fume: Maximum 50 percent by weight.

J. Water-Cementitious Material Ratio: As indicated on the Contract Drawings
    1. Slabs-on-Grade: Water to cement content shall not exceed a ratio of 0.42 upon delivery at site.
    2. Other Concrete Not in Contact with Soils: Water to cement content shall not exceed a ratio of 0.45 upon delivery to site.

K. Maximum Slump: As indicated on the Contract Drawings

L. Accurately control the proportions, water content, and air content. Use weighing equipment accurate to within 1 percent for cement and 2 percent for aggregates, and adjustable for varying aggregate moisture content. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.
    1. Proportion concrete by weight of loose, dry material.
    2. Fine aggregate volume shall be at least 35 percent of the sum of the separate fine and coarse aggregate volumes.

M. Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs and testing. Where admixture is proposed for use by concrete supplier, conform to types accepted by Architect in writing.
    1. Proposed admixtures shall be as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

N. Fiber Reinforcement: Add to mix at rate indicated on drawings and in accordance to manufacturer's instructions. Provide uniform and complete distribution based on manufacturer's recommendations.

O. Tests for Concrete Materials at Batch Plant: Utilizing batch plant test records, perform the following tests in accordance with provisions of the building code:
    1. Cement: Sample and test cement, or provide mill test reports, as accepted, certifying that the cement conforms to the requirements of this Specification.
    2. Aggregate:
        a. Sample and test concrete aggregate for grading and soundness before concrete mix designs are established.
        b. Test aggregate for shrinkage characteristics in accordance with ASTM C157/C157M.
        c. Conduct petrographic examinations of aggregate proposed for use in accordance with ASTM C295/C295M.
    3. Air Content: ASTM C173/C173M, volumetric method or ASTM C231/C231M, pressure method. One test for each set of compressive strength test specimens.
    4. Refer to "Field Quality Control" in Part 3 for testing of actual concrete mix and placement.

P. Inspection: Accompany each load of materials or concrete with a signed copy of batch plant's certificate stating quantity of each material, design strength, amount of water added at plant, admixtures, departure time and date, and maximum amount of water allowed to be added at site.

Q. Shrinkage Test:
    1. Before placing any concrete, prepare a trial batch of the mix design, using the same aggregates, cement, and admixtures (if any) proposed for use on the project. Prepare at least three specimens for determining the drying shrinkage of the mix design.

2. The drying shrinkage specimens shall be 4"x4"x11" prisms, made, cured, dried, and measured as specified in ASTM C157/C157M7. Measure and report separately for 7, 14, 21, and 28 days of drying. After 7 days of moist curing. The effective gauge length of the specimens shall be 10 inches.
3. The average drying shrinkage of the test specimens after 28 days of drying shall not exceed 0.045 percent for footing and grade beams, and 0.035 percent for all other locations. Use adequate amount of shrinkage reducing admixture as required.

2.10 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M and ASTM C94/C94M.
   1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
   2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 60 seconds for each additional 1 cu. yd. (0.76 cu. m).
   3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.
   4. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
   5. Fiber Reinforcement: Batch and mix as recommended by manufacturer for specific project conditions.

B. Transit Mixers: Comply with ASTM C94/C94M.
   1. With each load, provide ticket certifying the materials and quantities as well as compliance with the accepted mix design.

C. On the transit mix ticket, state the time water was first added to the mix.
   1. At the batch plant, withhold 2-1/2 gallons of water per cubic yard of concrete.
   2. Upon arrival at the job site, as directed by the Testing Laboratory Inspector, add all or part of the withheld water before the concrete is discharged from the mixer.
   3. Mix concrete for not less than 5 minutes after the withheld water has been added, and not less than 1 minute of that time immediately prior to discharge of the batch.
      a. Drum shall rotate approximately 70 to 100 revolutions at a mixing speed of approximately 6 to 18 rpm.
      b. After mixing, drum shall rotate at an agitating speed of approximately 2 to 6 rpm.
      c. Unless otherwise directed, provide 15 minutes total mixing per batch after first addition of water.
   4. Discharge of the concrete shall be completed within 90 minutes after water is introduced into the mix, or before the drum has completed 300 revolutions.

D. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

E. Weather Requirements:
   1. Hot Weather Usage: Adjust mix as required to counteract effects of anticipated or probable hot weather on strength of concrete. Conform to recommendations of ACI 305R regarding admixtures, temperature of mixing water, and delivery times.
      a. During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation that may impair required strength or serviceability of the member or structure.

b. When air temperature is between 85 degrees F. and 90 degrees F, limit mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, limit mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to performing work and placing concrete, verify:
   1. Lines, levels, and dimensions before proceeding with work of this section.
   2. Elevations and depressions of floor finishes
   3. Final excavation required for foundations and footings prior to placing concrete.
   4. Locations of proposed and future breathable and nonbreathable floor finishes in advance of placing concrete to determine type of floor sealers to be applied in finishing operations.
   5. Formwork is properly located such that the unshored concrete will maintain specified tolerances after forms are removed.

3.02 PREPARATION

A. Formwork: Comply with Section 031000 - Concrete Forming and Accessories.

B. Reinforcing: Comply with Section 032000 - Concrete Reinforcing.

C. Verify that forms are clean and free of rust before applying release agent.

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

E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning, roughening to exposed aggregate, and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use latex bonding agent only for non-load-bearing applications.

F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade over properly prepared subbase per Geotechnical recommendations. Lap joints minimum 6 inches. Tape and seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Place Slab on Grade directly on vapor retarder.
   2. Avoid grade staking through vapor retarder.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.
   1. Pour concrete in accordance with accepted pour schedule and construction joint layout.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Notify Architect not less than 48 hours prior to commencement of placement operations.

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

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

F. Place concrete continuously between predetermined construction joints per ACI and CBC requirements. Where construction joints are located, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

H. Compacting:
   1. General: Spade, rod, vibrate, and consolidate concrete in forms. Vibrators shall not be left in any one spot longer than 30 seconds and shall be kept constantly in motion. One vibrator shall be assigned to each location where concrete is being placed and a standby vibrator shall be kept ready at all times. Avoid creating rock pockets, air bubbles, honeycomb, or separation of ingredients.
   2. Work concrete thoroughly around reinforcement and embedded items and into corners and angles of forms by spading, rodding, and tamping.
   3. Consolidation: Vibrate to consolidate each layer with previously placed layers, completely embedding reinforcing and fixtures, and bringing fine material to surface of slab to produce proper finish.

I. Hot Weather Placing: Comply with recommendations of ACI 305R.

J. Cold Weather Placing: Comply with recommendations of ACI 306R.

3.04 GROUTING

A. Non-Shrink Grout: Install non-shrink grout per drawing properly beneath bearings of plates, columns, and other structural members using product recommended by manufacturer for specific application and in accordance with printed instructions.
   1. Compressive strength of grout shall be tested in accordance with ASTM C109/C109M .

3.05 CONTROL AND CONSTRUCTION JOINTS

A. Control Joints:
   1. Location: As indicated on the Contract Drawings, but not more than 20 feet on centers in both directions at exterior slabs. Limit interior slabs on grade to 400 square foot bays with length to width ratios of 1 to 1.5 maximum.
      a. Locate on column center lines and at re-entry corners wherever practical.
      b. Avoid areas receiving tile or paver floor finish.
      c. Coordinate locations with proposed floor finish joint layout.
      d. Limit length to width ratios to 1 to 1.25.

B. Anchor joint fillers and devices to prevent movement during concrete placement.

C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; with width and depth as indicated on drawings.
   1. Fill saw cuts in interior walkways with control joint filler specified.

E. Construction Joints:
   1. Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:
   2. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.
   3. A mix containing the same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.
   4. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.

3.06 SEPARATE NON-STRUCTURAL FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required dividers, edge strips, reinforcing, and other items to be cast in.

C. Non-structural toppings slabs shall be normal-weight concrete, reinforced as noted on the Contract Drawings.

D. Place concrete floor toppings to required lines and levels.
   1. Place topping in checkerboard panels not to exceed 20 feet in either direction.

3.07 TOLERANCES FOR CONCRETE CONSTRUCTION AND MATERIALS

A. An independent testing agency, as specified in Section 014000, will inspect finished slabs for compliance with specified tolerances.

B. Conform to requirements of ACI 117, except as modified by the requirements of these Specifications and CBC.

C. Formed Surfaces:
   1. Maintain bowing, warping, and dimensional tolerances within the maximum tolerances stated in ACI 117 for Class A surfaces.
   2. Overall Dimension for Height and Width: Plus zero to minus 3/32-inch for surfaces that are 10 feet and over.
   3. Thickness: Plus-or-minus 1/8-inch maximum.
   4. Openings: Accurate to within a tolerance of plus 1/8-inch to minus zero.
   5. Exposed Slab Edges: Free of jogs exceeding 1/8-inch.

D. Concrete Slabs: Floor finish tolerances shall be measured in accordance with ASTM E1155/E1155M and ACI 302.1R the F-Number System (Inch-Pound Units) for the following conditions:

Element	Specified Overall Value		Minimum Local Value	
	FF	FL	FF	FL
Slab-on-Grade:				
Mech and Electrical Rooms, parking structures	20	15	15	10
Carpeted	25	20	17	15
Thinset Tile, Resilient Flooring	35	25	24	17
Wood Flooring	50	35	35	35
Other not indicated	35	25	24	17
Suspended Slabs:				
Mechanical and Electrical Rooms, parking structures	20	15 (SHORED)	N/A	N/A
Carpeted	25	20 (SHORED)		
Thinset Tile, Resilient Flooring	35	25 (SHORED)		
Wood Flooring	50	35 (SHORED)		
Other not indicated	35	25 (SHORED)		

E. Verify flatness requirements in accordance with Owner's specification requirements prior to installation.

F. Suspended Slab Levelness: Where FL is not specified (unshored conditions) floors must be level, and the elevation of the top surface shall fall within a 3/4-inch envelope in accordance with ASCC Tolerances for Suspended Concrete Slabs, unless part of a sloping floor or as otherwise noted.

G. Concrete Door Sills:
   1. Slabs Under Operable Partitions or Sound-Rated Accordion Doors: 1/8-inch from level along line under partition or door.
   2. Slabs Under Roll-up Doors: 1/8-inch from level along line under partition or door.

H. Levelness tolerances shall be measured within 72 hours after slab concrete placement.
   1. Tolerances for sloped floors shall not exceed the slopes specified in "REGULARTORY REQUIREMENTS" in Part 2.

I. Owner reserves the right to test floors and concrete members for conformance to ACI 117 by Use of the Dipstick Floor Profiler. Should tolerances not be within the limits specified, the Contractor shall be required to pay the cost of the tests, as well as the repairs required to bring work into compliance.

J. Corrective Procedures: See "FILLING, LEVELING AND PATCHING."
   1. Areas requiring corrective work should be identified and submitted to Architect. Re-measure corrected areas by the same process.

3.08 CONCRETE FINISHING

A. Formed Concrete
   1. Surface Repairs: Repair surface defects, including defective areas and tie holes as recommended in ACI 301 Section 2 or 6.
   2. Rough-Formed Finish: Cast concrete texture imparted by form-facing material, not arranged in any specific visual manner. Repair and patch tie holes and defective areas. Rub down or chip off fins and other projections exceeding 1/4-inch in height.
      a. Apply to concrete surfaces not exposed to public view.
   3. Smooth-Formed Finish: Cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.
      a. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, or painting.
      b. Apply the following rubbed finish, defined in ACI 301 Section 6, to smooth-formed finished concrete.
         1) Grout-cleaned finish.
         2) Smooth-rubbed finish.
   4. Painted Finish: Entire surface area exposed to view shall be free of voids, cracks, spalls, protrusions, or non-uniform textures.
      a. Prior to sacking, prepare surfaces in accordance with Section 099113 - Exterior Painting and Section 099123 - Interior Painting as applicable.
      b. Entire surface area of concrete exposed to view shall be repaired, resurfaced, and made ready to receive paint finish specified under Section 099113 - Exterior Painting and Section 099123 - Interior Painting as applicable.
         1) Resurfacing of concrete panel surfaces shall be accomplished with specified resurfacing materials in accordance with manufacturer's instructions and the preparation and application procedures of ACI 503.4.
      c. Interior surfaces at window openings shall be ground smooth, resurfaced, and prepared to receive sealants.

1) Resurface concrete sills, jambs, and heads with specified resurfacing, patching, and finishing materials in accordance with manufacturer's instructions.
(a) Interior surfaces at openings shall be ground smooth, resurfaced, and prepared to receive sealants.

d. Finish repaired surfaces with primer and two coats of paint finish as specified under Section 099113 - Exterior Painting and Section 099123 - Interior Painting as applicable.

5. Related Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
6. Electrostatic Coatings: Install in accordance with manufacturer's printed instructions.
7. Patching and Skim Coating: Refer to "FILLING, LEVELING AND PATCHING."

B. Flatwork
1. Screeding: Work out irregularities and bring surfaces to true finish grade or elevation. Remove excess water and debris worked to the surface during compaction and screeding.
2. Initial Troweling:
a. Do not commence troweling until surface water sheen has disappeared.
b. Use wood bullfloats to open top of slab to allow bleed water out.
c. Do not use metal floats.
d. Do not apply dry cement, sand, or water to surface.
e. Slabs to Receive Mortar-bed with Topping or Bonded Finish: Upon completion of pour, and before concrete has hardened, texture surface of slab with stiff broom, or roughen surface.
f. Slabs to Receive Crack Isolation Membrane or Mortar-bed with Cleavage Membrane: Finish slabs with typical smooth troweled surface.
3. Final Troweling:
a. Interior Slabs: Steel trowel and burnish.
1) Do not finish slab until bleed water has evaporated.
2) Do not apply water to the concrete during finishing.
3) Do not allow rainwater to stand on slab.
b. Sills and Other Weather Surfaces: Smooth trowel and burnish. Finish external angles uniform and tooled.
c. Sealer: Where specified, apply in accordance with the requirements of Section 033511.
4. Finish for Interior Stairs:
a. Sprinkle abrasive aggregate uniformly on unhardened surface immediately prior to finishing, at the rate of 2 pounds per square yard. Work into surface during finishing. Rub lightly to expose abrasive aggregate while concrete is green.
b. Concrete walking surfaces shall have a minimum slip resistance coefficient of friction of 0.6 as tested in accordance with ASTM D 2047.
c. Stairs: Apply grooves and tooled edges to tread nosing in accordance with the Contract Drawings.
1) Provide medium broom finish.
d. Warning Stripes: Apply 2-inch wide warning stripe of 70 percent contrasting color at top and bottom nosing of each run at interior stairs, 1 inch maximum from edge of nosing.
e. Pedestrian, General:
1) Provide medium broom finish.
2) Medium acid etch finish.
5. Float Finish:

a. After screeding, consolidating, and straightening concrete slabs, do not work surface until ready for floating.
b. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats. The application of Portland cement to slab during floating or troweling is prohibited.
c. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and frill low spots. Repeat float passes and straightening until surface is left with a uniform, smooth, granular texture.
d. Finish to straightedge tolerance.
e. Cut down high areas and fill in low areas.
f. After straightening, refloat surface to uniform, smooth, granular texture.
g. Locations:
1) Surfaces scheduled for trowel and broom finishes.
2) Surfaces scheduled to receive adhered roofing or waterproofing membrane.
3) Surfaced scheduled to receive thick-set mortar beds on cleavage membrane.

6. Trowel Finish:
a. After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
b. Finish to straightedged tolerance.
c. Locations:
1) Surfaces scheduled to receive thin-set mortar beds, resilient flooring, carpet, and wood flooring.
2) Exposed surfaces.
3) Surfaces scheduled to receive paint or other thin film finish coating.

7. Medium Broom Finish:
a. Provide float finish and let set.
b. While surface is still plastic draw medium stiff fiber bristle broom uniformly over surface to provide texture perpendicular to main traffic direction.
c. Locations:
1) Stair treads.

8. Heavy Broom Finish:
a. Provide float finish and let set.
b. Texture: While surface is still plastic, swirl stiff fiber bristle broom uniformly over level surfaces and perpendicular to main traffic direction at ramp surfaces.
c. Locations:
1) Parking garage areas.

9. Acid Wash: Top-Cast No. 3 Light Etch.
a. Provide acid containment area and comply with CAL OSHA for application and cleanup.
b. First Wash: Three days after pour.
c. Second Wash: Three weeks after first application.
d. Third Wash: At time of final completion of Project.
e. Appearance: Slab surfaces shall exhibit an aggregate exposure of fine aggregate particles constituting not less than 60 percent and not more than 80 percent of the surface, as directed by Architect. Exposure shall be of sufficient depth to provide a surface profile of between 1/16-inch and 3/16-inch.

10. Electrostatic Control Coating: Install in accordance with manufacturer's recommendations.

C. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:

1. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

3.09 SEALING

A. Formed Concrete Surface:
   1. Interior Vertical Surfaces: Where indicated on Contract Drawings, treat vertical surfaces of interior exposed formed concrete with specified sealer finish Type WSR.
      a. Apply protective treatment in saturating applications without atomizing the product. Use enough to thoroughly wet the surface and create a slight rundown below the spray pattern. Apply uniformly. Don't over apply.
         1) Provide two applications of protective treatment at exposed concrete toilet room wall locations. Apply the second coat within a few minutes after the first coat has penetrated and appears dry; do not atomize the product during application.
      b. Brush heavy runs and drips thoroughly into the surface.
      c. Protect treated surfaces from contact or by water or for 4 hours.
   2. Exterior Vertical Surfaces: Where indicated on Contract Drawings, treat vertical surfaces of exterior exposed formed concrete with sealer in accordance with specified sealer finish Type FSF.

B. Flatwork
   1. Grind and clean floors prior to sealing.
   2. Sealer/Dustproofer:
      a. Prepare substrates and spray apply curing sealer in accordance with manufacturer's directions.
      b. Locations:
      c. Mechanical rooms, main trash room, electrical rooms, and telephone rooms.
      d. Other locations where indicated or scheduled in Contract Drawings.
   3. Penetrating Sealer:
      a. Sealed Concrete Type SC2: Polish with clear finish in accordance with Section 033513 - High-Tolerance Concrete Floor Finishing.

3.10 CURING

A. Comply with requirements of ACI 308R and ACI 318. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.

C. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.

D. Surfaces Not in Contact with Forms:
   1. Curing Compound: Cure by completely and uniformly applying liquid curing compound in accordance with manufacturer's printed instructions. Apply at least two coats at right angles to each other.
      a. Reapply curing membrane at saw cut joints and at exposed edges of slab after removal of forms.
      b. Omit curing compound and use moisture curing where required to provide floor sealer.
      c. Omit curing compound where curing/sealing compound specified provides a concurrent curing function and is applied at the time of concrete placement appropriate to such function.

d. Slabs and floors to receive adhesive-applied flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.

2. Continuous Moisture: Cure by keeping concrete continuously wet for a period of at least 7 days after pouring in accordance with ACI 308R and ACI 318 for curing interior slabs to receive flooring finishes. During periods of high temperature, low humidity, or wind, wet concrete as often as required to keep concrete continuously moist for a period of at least 10 days. Cover with waterproof curing paper or reinforced vapor retarder, maintaining a film of water.
3. Final Curing: Begin after initial curing but before surface is dry.

E. Ambient Conditions:
1. Hot Weather Curing:
2. Conform to recommendations of ACI 305R regarding curing of concrete flatwork in hot weather.

3.11 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

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

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Testing:
1. Sample fresh concrete in accordance with ASTM C172/C172M, except modified for slump to comply with ASTM C94/C94M.
2. Slump: Test will be performed in accordance with ASTM C143/C143M. One test will be made for each concrete load at point of discharge and one test for each set of compressive strength test specimens.
3. Concrete Temperature: Test will be taken hourly when air temperature is 40 degrees F or below, and when 80 degrees F or above, and each time a set of compression test specimens is made.
4. Curing: Cure specimens in accordance with ASTM C31/C31M.
5. Frequency of Compressive Strength Testing: Test will be made in accordance with ASTM C39/C39M, ACI 318, CBC Chapter 19, and Table 1705.3.
a. Test one set of four cylinders for each concrete class placed in any one day for each 50 cubic yards or fraction thereof, or for each 2000 square feet of surface area placed. One specimen will be tested at 7 days, two at 28 days, and:
1) When frequency of testing will provide less than five strength tests for a given class of concrete, testing from at least five randomly selected batches, or from each batch if fewer will be conducted.
b. If the average of strength tests of all strength tests of a given class of concrete equals or exceeds the specified strength at 28 days, with no individual strength test less than 500 psi below that specified, the strength level of concrete will be considered satisfactory.
c. Retain one cylinder for testing at 56 days if 28-day test fails.

E. Moisture Vapor Emission Testing: After concrete slabs have cured and prior to installation of finish flooring materials, verify that moisture content and alkali content of concrete slabs do not exceed limits acceptable to manufacturer of flooring materials.

1. Testing Equipment: Test methods based on ASTM F2170 using RH meters and testing kits equal to AMT Moisture/Relative Humidity Meter manufactured by American Moisture Test, Inc., or equivalent by Vaprecision Testing Systems may be used at testing agency's option except at concrete floors with exposed or polished finish.
2. Alkalinity: Concrete pH test using calibrated digital 1-14 wide range pH meter equal to PH100 to determine alkalinity level in accordance with ASTM F710. Paper and pencil type tests are not acceptable.
3. Calcium Chloride Testing: After building air conditioning has been in operation for at least 15 days, calcium chloride and pH testing kits may be used: Prepackaged test kit of commercial consistency, equipped with a sealed dish of anhydrous calcium chloride, a metering dome with butyl rubber gasket and instructions for implementation. Weigh dishes on site prior to installation. Conform with requirements of ASTM F1869.

F. Vapor Emission and Alkalinity Testing:
1. Perform vapor emission and alkalinity testing and take appropriate action based on results in relation to finish floor manufacturer's moisture and alkalinity requirements.

3.12 FILLING, LEVELING AND PATCHING

A. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired, or as directed by Architect.
1. High spots shall be honed, or ground with power-driven machines to required tolerances with approval from Architect.
2. Low spots shall be filled with floor leveling compound, installed in accordance with manufacturer's written recommendations.

B. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.

C. Patching Exposed Concrete: After flushing with water, pack tie wire, nail, bolt, and core sample holes which will be exposed as soon as possible after form removal. Grout and repair rough pockets, cracks, or honeycomb. If patches are required, chip defective areas to a uniform depth of at least 1 inch with sides at right angles to surface.
1. Match surrounding concrete surfaces in color and texture. Make trial patch to determine color match. Before applying, moisten surrounding concrete and apply specified bonding compound.
2. Smooth Formed Concrete: Grind off ridges, offsets, and other prominent marks of smooth formed concrete while concrete is green and grind smooth. Sack exposed concrete surfaces.
a. Painted concrete shall be considered as being exposed.
3. Patch defects deeper than 1/2-inch in panels with specified patching material and methods deemed by the Architect as the appropriate method to correct such defects.

D. Skim Coating: Where sack and patch is noted on Contract Drawings, apply to architectural formed cast-in-place concrete walls in accordance with manufacturer's instructions.
1. New concrete must be cured 28 days.
2. pH must be verified prior to skim coating application to determine if primer needs to be applied, as required by manufacturer.
3. Clean concrete in accordance with ASTM D4258.
4. Mixing Skim Coat:
a. Add to water, adding only enough to make a stiff trowelable consistency like soft putty.
b. Add color additive.
c. Working Time: Approximately 15 minutes.

5. Apply to walls with trowel in smooth uniform coat in continuous operations to maintain a uniform shade.
6. Patching: Broad deep areas in concrete surface shall be filled with skim coat material in accordance with manufacturer's directions prior to application of skim coat. Where surfaces are shiny smooth, apply manufacturer's Type II bonding agent.

E. Patching Unexposed Concrete: Ridges, offsets, and other prominent marks need not be ground off, cleaned, or sacked. This requirement applies to concrete areas that will be concealed by other construction.
1. Finish below-grade concrete indicated to receive waterproofing in the same manner as exposed, smooth-formed concrete, except that surfaces need not be sacked.
2. Patch and repair concrete slabs ready to receive future finish materials installed by Owner.

3.13 DEFECTIVE CONCRETE

A. Strength
1. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
2. If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, falls below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.
3. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective and shall be evaluated by Architect and replaced or adequately strengthened in a manner acceptable to the Architect and DSA.
4. Test Cores: Should required test cylinders fail to show minimum design compressive strength, take test cores at locations coordinated with the Architect.
a. If results show compressive strength to be less than design stress, concrete shall be deemed defective and shall be replaced in a manner acceptable to the Architect and DSA.
b. If results show compressive strength to conform to design stress, grout solid coring holes with grout exceeding design compressive strength and finish to match adjacent surface.

B. Concrete Work that is not formed as indicated, is not true within tolerances of span, not true to intended alignment, not plumb or level where so intended, not true to intended grades and levels, cracked, contains sawdust shavings, wood or embedded debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.

C. Concrete substrates for non-breathable floor finishes that indicate by testing excess quantities of moisture and alkalinity shall require remedial measures, as specified in this Section.

D. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing, including patching for cores, shall be borne by Contractor when defective concrete is identified.

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

3.14 CLEAN UP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

B. Wash and clean flatwork surfaces. Leave free from oil, paint, plaster, form coating, and other foreign substances, ready to receive scheduled finishes.

3.15 PROTECTION

A. Protect the Work of this section until Substantial Completion.

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

END OF SECTION

SECTION 099620
PERMANENT NON-SACRIFICIAL ANTI-GRAFFITI COATING

PART 1 - GENERAL

1.01 **SECTION INCLUDES**

A. Anti-graffiti coating systems vertical surfaces for cast stone, brick masonry, concrete unit masonry (painted and unpainted), cast-in-place building concrete, cast-in-place site concrete, and architectural site concrete..

B. Surface preparation

C. field application

1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 033000 - Cast-in-Place Concrete; Bulidng concrete

C. Section 079005 - Joint Sealers; Joint sealants.

D. Section 323353 - Architectural Site Concrete

1.03 REGULATORY REQUIREMENTS

A. California Air Resources Board, Volatile Organic Compound (VOC) Limitation: Provide anti-graffiti coating materials, including primers, undercoats, and finish-coat materials, that have a VOC content of 100 g/l or less, consistent with Southern California Air Quality Management District (SCAQMD) Rule 1113 for architectural flat coatings.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating coating materials .

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include cleaning procedures and repair and patching techniques.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Coating Materials: 1 gallon of each type and color.
   2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document that applies to application on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

C. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.06 MOCK-UP

A. Apply Sealer and Anti-graffiti coating to approved Architectural Site Concrete Mock-ups for review and approval by Architect and client prior to beginning work.

B. Locate where directed.

C. Mock-up may not remain as part of the Work.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within one year period after Date of Substantial Completion.

C. Warranty: Include coverage for bond to substrate.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Products: The design for each non-sacrificial anti-graffiti coating system is based on the products indicated.

B. Type 2, Silane/Siloxane-Based Systems:
   1. Rainguard International Inc., VandlGuardTEN non-sacrificial Anti-Graffiti System.
      a. Sealer; Product Micro-Seal Water Repellant.
      b. Non-Sacrificial Coating; Product VandlGuardTEN
      c. Finish Coat; Product VandlGuard Finish Coat.

2.02 PERFORMANCE REQUIREMENTS

A. General: Non-sacrificial anti-graffiti coating system with the following properties:
   1. Superior protection against, and easy removal of, unwanted graffiti.
   2. Minimum alteration of appearance of treated surface when compared to untreated surface, including gloss and color.
   3. Minimum alteration of water vapor transmission rate through complete wall system.
      a. Coating system shall have a minimum water vapor transmission rate of 95 percent when tested per ASTM D1653.

B. Completed coating system performance shall comply with ASTM D 6578 “Standard Practice for Determination of Graffiti Resistance,” and the following:
   1. Cleanability Level 3: Achieve Level 3 cleaning performance, removing all test graffiti items using citrus-based cleaners or milder solvents.

C. Apply to all exposed surfaces of site architectural concrete vertical surfaces.
   1. Cast in place concrete.
   2. Concrete masonry units.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which anti-graffiti coatings will be applied, for compliance with coating application requirements.

B. Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.

3.02 PREPARATION

A. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item; provide surface-applied protection before surface preparation and coating.
   1. After completing coating operations, reinstall items that were removed, using workers skilled in the trades involved.

B. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each substrate condition and as specified.
   1. Prepare concrete to be coated. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.
   2. Surfaces to receive sealer shall be cleaned of dirt, oil, graffiti, grease, laitance, and other contaminants.
   3. Mid-pressure water (1500 psi) washing is the minimum cleaning that will be accepted, other methods, such as abrasive blasting and power may be submitted for review.
   4. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.

C. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
   2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application.
   3. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
   4. Use only the type of thinners approved by manufacturer and only within recommended limits.

D. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of coating system components. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of components being deposited on surfaces. Cover live plants and grass.

E. Coordination with Sealants: Do not apply anti-graffiti coatings until sealants for joints adjacent to surfaces receiving coatings have been installed and cured.
   1. Anti-graffiti coating work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, anti-graffiti coatings, and sealant materials identical to those used in the work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 APPLICATION

A. General: Apply anti-graffiti coatings according to manufacturer's written instructions.
   1. Use applicators and techniques best suited for the material being applied.
   2. Do not apply anti-graffiti coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
   3. Coating surface treatments and finishes are indicated in the coating system descriptions.
   4. Provide finish coats compatible with primers used.
   5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, drinking fountains, grilles, covers for electrical equipment, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

B. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.

1. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.

C. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

D. The number of coats and film thickness required is the same regardless of application method.
1. Micro-Seal- one (1) coat
2. VandlGuard TEN- two (2) coats
3. VandlGuard Finish Coat- one (1) coat

E. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. Allow sufficient time between successive coats to permit proper drying.

F. Give special attention to edges, corners, crevices, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.

G. Application Procedures: Apply coatings according to manufacturer's written instructions.
1. Spray Equipment: Use spray equipment with pressure and orifice size recommended by manufacturer for material and texture required.

H. Minimum Coating Thickness: Apply each material no thinner than manufacturers recommended spreading rate.
1. Provide total dry film thickness of the entire system as recommended by manufacturer.

I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.

J. Recoat primed and sealed substrates immediately if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn -through or other defects caused by insufficient sealing.

K. Completed Work: Match accepted mockups for shade and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.04 FIELD QUALITY CONTROL

A. Provide the services of the manufacturer's authorized field representative to verify that installed products comply with manufacturer's requirements and with the standard established by the Architect approved mockup/test panels.

B. Remove and replace work where test results indicate that it does not comply with specified requirements.

3.05 CLEANING

A. Immediately clean anti-graffiti coatings from adjoining surfaces and surfaces soiled or damaged by application as work progresses. Repair damage caused by application. Comply with manufacturer's written cleaning instructions.

B. Clean up debris and unused material and remove from site.

3.06 PROTECTION

A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

SECTION 116833
ATHLETIC FIELD EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outdoor basketball equipment.
B. Volleyball equipment.
C. Tetherball Assembly

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Footings for field equipment.
B. Section 312200 - Grading: Shaping subgrade to specified grade levels.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.
C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
D. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.
E. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
F. ASTM B108/B108M - Standard Specification for Aluminum-Alloy Permanent Mold Castings; 2019.
G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
J. ASTM D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position; 2018.
K. ASTM D6662 - Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards; 2022.
L. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Convene a meeting one week before starting this work to discuss coordination between various installers.
   1. Require attendance by personnel responsible for grading and installers of athletic field equipment, footings, and adjacent work.
   2. Include representatives of Contractor.

3. Notify Architect at least two weeks prior to meeting.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide athletic field equipment manufacturer's product data indicating materials of construction, compliance with specified standards, installation procedures, and necessary safety limitations.

C. Shop Drawings: Submit detailed scale drawings showing athletic field equipment and perimeter layout.
   1. Indicate locations and dimensions of footings and anchorage points.
   2. Identify mounting elevations in relation to fixed survey point on site, and subgrade elevation.
   3. Indicate location of underground utilities, storm drainage system, and irrigation system.
   4. Indicate location of surface utility boxes.

D. Maintenance Data: Submit manufacturer's recommended maintenance instructions and list of replaceable parts for each athletic field equipment item, along with supplier's address and phone number.

E. Installer's Qualification Statement.

F. Executed Warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store equipment on project site in accordance with manufacturer's recommendations.

B. Store materials in a dry, covered area, and elevated above grade.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum 10 year manufacturer warranty for Basketball backstop frames athletic field equipment. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Athletic Field Equipment:
   1. Porter Athletic: https://www.gillporter.com/porter

2.02 ATHLETIC FIELD EQUIPMENT - GENERAL

A. Mount supporting posts in concrete footings, unless otherwise indicated, refer to Section 033000 for additional concrete footing installation requirements.

B. Coordinate field grading as required for proper placement and arrangement of equipment, refer to Section 312200 for additional information.

2.03 OUTDOOR BASKETBALL EQUIPMENT

A. Manufacturers:
   1. Porter Athletic
      a. Backboard: Fiberglass fan board 54"x39"
      b. Post:Gooseneck style w/ 6 feet extension
      c. Goal and net:Double rim w/ nylon net
      d. Post pad
   2. Substitutions: See Section 016000 - Product Requirements.

2.04 VOLLEYBALL EQUIPMENT

A. Manufacturers:
   1. Porter Athletic
      a. Post
      b. Ground Sleeve
      c. Net
   2. Substitutions: See Section 016000 - Product Requirements.

2.05 TETHEBALL

A. Manufacturers:
   1. Porter Athletic
      a. Post
      b. Sleeve
      c. Ball
   2. Substitutions: See Section016000-Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that athletic field equipment area has been graded to subgrade elevations required and that excess soil, rocks, and debris has been removed as necessary for installation of footings.

B. Verify that athletic field equipment footings have been installed in proper locations and at proper elevations.

C. Verify location of underground utilities and facilities in athletic field equipment area; damage to underground utilities and facilities will be repaired at Contractor's expense.

3.02 PREPARATION

A. Stake location of athletic field equipment elements, including necessary athletic field perimeters, surfacing, access and egress points, hard surfaces, walls, fences, _____, and/or structures.

B. Stake layout of athletic field equipment perimeter in accordance with approved shop drawings before starting any work.
   1. Verify that athletic field perimeters do not overlap hard surfaces, whether currently installed or not.
   2. Verify that athletic fields are free of obstructions.

3. If conflicts or obstructions are found, notify Architect.
4. Do not proceed with this work until revised drawings have been provided, showing corrected layout, and that any obstructions have been removed or corrections to layout have been made.

3.03 INSTALLATION

A. Install concrete footings below paving/finish surface, unless otherwise indicated.

B. Install athletic field equipment in accordance with manufacturer's instructions, and rules and regulations of specified athletic association indicated for this work.

C. Install backboards and goal posts plumb, level, and rigid using manufacturer provided attachment hardware, and ensure backstops are accurately positioned and free of vibrations.

D. Install athletic field equipment without sharp points, edges, or protrusions; entanglement hazards or pinch, crush, or shear points.

3.04 CLEANING

A. Clean athletic field equipment of construction materials, dirt, stains, filings, and blemishes due to shipment or installation; clean in accordance with manufacturer's instructions, using cleaning agents as recommended by manufacturer.

B. Clean athletic field area of excess construction materials, debris, and waste.

C. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.

3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 260505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

2.01 SECTION INCLUDES

A. Electrical demolition.

2.02 RELATED REQUIREMENTS

A. Section 017000 - Execution and Closeout Requirements: Additional requirements for alterations work.

2.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 PRODUCTS

3.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

4.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Owner before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

4.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Notify local fire service.
   3. Make notifications at least 24 hours in advance.
   4. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner at least 24 hours before partially or completely disabling system.
   2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
   3. Make temporary connections to maintain service in areas adjacent to work area.

4.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
   2. PCB- and DEHP-containing lighting ballasts.
   3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

4.04 CLEANING AND REPAIR

A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace broken electrical parts.

END OF SECTION

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Nonmetallic-sheathed cable.
C. Underground feeder and branch-circuit cable.
D. Service entrance cable.
E. Armored cable.
F. Metal-clad cable.
G. Power and control tray cable.
H. Wiring connectors.
I. Electrical tape.
J. Heat shrink tubing.
K. Oxide inhibiting compound.
L. Wire pulling lubricant.
M. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
C. Section 260536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
F. Section 263100 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.
G. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.
H. Section 312316 - Excavation.
I. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
J. Section 312323 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2021).
F. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.
G. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
H. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); 2008a (Validated 2019).
I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
J. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
K. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2024.
L. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
M. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O. UL 4 - Armored Cable; Current Edition, Including All Revisions.
P. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
Q. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
R. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
S. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
T. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
U. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
V. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
W. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.
X. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.
Y. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.

D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual installed circuiting arrangements. Record actual routingfor underground circuits.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
   1. Exceptions:
      a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
      b. Use power and control tray cable or metal-clad cable for installation in cable tray.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Armored cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
         1) Maximum Length: 6 feet.
   2. In addition to other applicable restrictions, may not be used:
      a. Unless approved by Owner.
      b. Where not approved for use by the authority having jurisdiction.
      c. Where exposed to view.
      d. Where exposed to damage.
      e. For damp, wet, or corrosive locations.
      f. For isolated ground circuits.

F. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

H. Minimum Conductor Size:12 AWG.
   1. Branch Circuits: 12 AWG.
      a. Exceptions:
         1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
         2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
         3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
   2. Control Circuits: 14 AWG.

I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

J. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code:
      a. 480Y/277 V, 3 Phase, 4 Wire System:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral/Grounded: Gray.
      b. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      c. 240/120 V High-Leg Delta, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B (High-Leg): Orange.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      d. 240/120 V, 1 Phase, 3 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Neutral/Grounded: White.
      e. Equipment Ground, All Systems: Green.
      f. Isolated Ground, All Systems: Green with yellow stripe.
      g. Travelers for 3-Way and 4-Way Switching: Pink.
      h. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Cerro Wire LLC: www.cerrowire.com.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. General Cable Technologies Corporation: www.generalcable.com/#sle.
      d. Southwire Company: www.southwire.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Installed Underground: Type XHHW-2.
      c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.04 SERVICE ENTRANCE CABLE

A. Manufacturers:
   1. Copper Service Entrance Cable:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.

B. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: 600 V.

2.05 ARMORED CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN.

F. Grounding: Combination of interlocking armor and integral bonding wire.
   1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.

G. Armor: Steel, interlocked tape.

2.06 POWER AND CONTROL TRAY CABLE

A. Manufacturers:
   1. Encore Wire Corporation: www.encorewire.com/#sle.
   2. General Cable Technologies Corporation
   3. Okonite: www.okonite.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.

C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities having jurisdiction, provide tray cable marked as Type TC-ER in accordance with NFPA 70.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Insulation: Type XHHW or XHHW-2.

G. Grounding: Full-size integral equipment grounding conductor.

H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.07 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 260526.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
   5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
   7. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.

H. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
   2.
      a. Burndy LLC: www.burndy.com/#sle.
      b. Bundy, LLC

c. Ilsco: www.ilsco.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.

J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.

2.08 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Burndy LLC: www.burndy.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.
c. Ilsco: www.ilsco.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. American Polywater Corporation: www.polywater.com/#sle.
      c. Ideal Industries, Inc: www.idealindustries.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
   9. Provide oversized neutral/grounded conductors where indicated and as specified below.
      a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
      b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install armored cable (Type AC) in accordance with NECA 120.

E. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

H. Terminate cables using suitable fittings.
   1. Armored Cable (Type AC):
      a. Use listed fittings and anti-short, insulating bushings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

I. Install conductors with a minimum of 12 inches of slack at each outlet.

J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

M. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.

a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

O. Insulate ends of spare conductors using vinyl insulating electrical tape.

P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.
D. Ground bars.
E. Ground rod electrodes.
F. Chemically-enhanced ground electrodes.
G. Ground plate electrodes.
H. Ground enhancement material.
I. Ground access wells.

1.02 RELATED REQUIREMENTS

A. Section 096500 - Resilient Flooring: Static control flooring.
B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.
C. Section 260536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 263100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
F. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
G. Section 337900 - Site Grounding.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. NFPA 99 - Health Care Facilities Code; 2024.
G. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2023.

H. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 096900.
   4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:
   1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
   3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

E. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   4. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   5. Ground Rod Electrode(s):
      a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
      b. Space electrodes not less than 10 feet from each other and any other ground electrode.
      c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
      d. Provide ground enhancement material around electrode where indicated.

e. Provide ground access well for each electrode.

6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
   b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
   c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
8. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

F. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

H. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
   a. Transformers (except autotransformers such as buck-boost transformers).
   b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
   c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.

6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
   b. Metal gas piping.
   c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

J. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

K. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
   a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.

b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
a. Exceptions:
1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
a. Exceptions:
1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
b. Burndy LLC: www.burndy.com/#sle.
c. Harger Lightning & Grounding: www.harger.com/#sle.
d. Thomas & Betts Corporation: www.tnb.com/#sle.
5. Manufacturers - Exothermic Welded Connections:
a. Burndy LLC: www.burndy.com/#sle.
b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
5. Manufacturers:
   a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
   b. Erico International Corporation: www.erico.com/#sle.
   c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
   d. Harger Lightning & Grounding: www.harger.com/#sle.

F. Ground Enhancement Material:
1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
2. Manufacturers:

G. Ground Access Wells:
1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
4. Cover: Factory-identified by permanent means with word "GROUND".
5. Manufacturers:
   a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
   b. Erico International Corporation: www.erico.com/#sle.
   c. Harger Lightning & Grounding: www.harger.com/#sle.
   d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.

E. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F. Identify grounding and bonding system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 260536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.

E. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

F. Section .

G. Section 262513 - Low-Voltage Busways: Additional support and attachment requirements for busway.

H. Section 263100 - Photovoltaic Collectors: Photovoltaic module mounting systems.

I. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

J. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
   1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.

E. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.

F. Installer's Qualification Statement: Include evidence of compliance with specified requirements.

G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Installer Qualifications for Field-Welding: As specified in Section 055000.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Components for Vibration Isolation and/or Seismic Controls: Comply with Section .

C. Materials for Metal Fabricated Supports: Comply with Section 055000.

D. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.

E. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
   1. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      d. Thomas & Betts Corporation: www.tnb.com/#sle.

F. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.
   2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
   3. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
   5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
   6. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Thomas & Betts Corporation: www.tnb.com/#sle.
      c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
      d. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

G. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch diameter.
      b. Busway Supports: 1/2 inch diameter.
      c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
      d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
      e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
      f. Outlet Boxes: 1/4 inch diameter.
      g. Luminaires: 1/4 inch diameter.

H. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
   1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
   3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
   4. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Erico International Corporation: www.erico.com/#sle.
      c. PHP Systems/Design: www.phpsd.com/#sle.
      d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.

I. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
   3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
   4. Hollow Masonry: Use toggle bolts.
   5. Hollow Stud Walls: Use toggle bolts.
   6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
   7. Sheet Metal: Use sheet metal screws.
   8. Wood: Use wood screws.

9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
14. Manufacturers - Mechanical Anchors:
    a. Hilti, Inc: www.us.hilti.com/#sle.
    b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
    c. Powers Fasteners, Inc: www.powers.com/#sle.
    d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide required vibration isolation and/or seismic controls in accordance with Section .

I. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
    5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Conduit Support and Attachment: Also comply with Section 260533.13.

K. Cable Tray Support and Attachment: Also comply with Section 260536.

L. Box Support and Attachment: Also comply with Section 260533.16.

M. Busway Support and Attachment: Also comply with Section 262513.

N. Interior Luminaire Support and Attachment: Also comply with Section 265100.

O. Exterior Luminaire Support and Attachment: Also comply with Section 265600.

P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

Q. Secure fasteners according to manufacturer's recommended torque settings.

R. Remove temporary supports.

S. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 260533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Aluminum rigid metal conduit (RMC).
C. Intermediate metal conduit (IMC).
D. PVC-coated galvanized steel rigid metal conduit (RMC).
E. Flexible metal conduit (FMC).
F. Liquidtight flexible metal conduit (LFMC).
G. Electrical metallic tubing (EMT).
H. Rigid polyvinyl chloride (PVC) conduit.
I. Reinforced thermosetting resin conduit (RTRC).
J. Conduit fittings.
K. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete encasement of conduits.
B. Section 078400 - Firestopping.
C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
D. Section 260526 - Grounding and Bonding for Electrical Systems.
    1. Includes additional requirements for fittings for grounding and bonding.
E. Section 260529 - Hangers and Supports for Electrical Systems.
F. Section 260533.16 - Boxes for Electrical Systems.
G. Section .
H. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
I. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
J. Section 271000 - Structured Cabling: Additional requirements for communications systems conduits.
K. Section 312316 - Excavation.
L. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
M. Section 312323 - Fill: Bedding and backfilling.
N. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit - Aluminum (ERMC-A); 2025.
D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2025.
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.
H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
N. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
O. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
P. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
Q. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
R. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
S. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Shop Drawings:
   1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
   2. Include proposed locations of roof penetrations and proposed methods for sealing.

D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
   5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
   6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.

7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

D. Embedded Within Concrete:
   1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
   4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.

E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT). Do not use MC cable in walls or ceilings except for the final connection to lighting fixtures, and less than 6' lengths.

F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.

H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
   1. Locations subject to physical damage include, but are not limited to:
      a. Where exposed below 8 feet, except within electrical and communication rooms or closets.

J. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Electrical Service Conduits: Also comply with Section 262100.

C. Communications Systems Conduits: Also comply with Section 271000.

D. Fittings for Grounding and Bonding: Also comply with Section 260526.

E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

F. Provide products listed, classified, and labeled as suitable for the purpose intended.

G. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   2. Underground, Interior: 3/4 inch (21 mm) trade size.
   3. Underground, Exterior: 1 inch (27 mm) trade size.

H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube, a Division of Zekelman Industries www.wheatland.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use aluminum.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
1. Allied Tube & Conduit www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.

3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

C. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
1. Manufacturers:
a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
b. O-Z/Gedney, a brand of Emerson Electric Co www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.

2.09 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit www.alliedeg.com/#sle.
   2. Republic Conduit www.republic-conduit.com/#sle.
   3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   4. Connectors and Couplings: Use compression (gland) type.
      a. Do not use indenter type connectors and couplings.
      b. Do not use set-screw type connectors and couplings.
   5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
   6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com/#sle.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
   3. JM Eagle www.jmeagle.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).

B. Supports: Per manufacturer's recommendations.

C. Fittings: Same type and manufacturer as conduit to be connected.

2.12 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

H. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
      b. Substitutions:

I. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for the casing and conduit/duct arrangement to be installed.
   1. Products:
      a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
      b. Substitutions:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.

E. Install intermediate metal conduit (IMC) in accordance with NECA 101.

F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

H. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   5. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across roofs.
      c. Across top of parapet walls.
      d. Across building exterior surfaces.
   6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   7. Arrange conduit to maintain adequate headroom, clearances, and access.
   8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   9. Arrange conduit to provide no more than 150 feet between pull points.
   10. Route conduits above water and drain piping where possible.
   11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.
   14. Group parallel conduits in the same area together on a common rack.

I. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide required vibration isolation and/or seismic controls in accordance with Section .
   3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   5. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
   7. Use conduit clamp to support single conduit from beam clamp or threaded rod.

8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
10. Use of spring steel conduit clips for support of conduits is not permitted.
11. Use of wire for support of conduits is not permitted.
    a. For securing conduits to studs in hollow stud walls.
    b. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).
12. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

J. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

L. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 312316.13.
2. Minimum Cover, Unless Otherwise Indicated or Required:

a. Underground, Exterior: 24 inches.
b. Under Slab on Grade: 12 inches to bottom of slab.

3. Provide underground warning tape in accordance with Section 260553 along entire conduit length for service entrance where not concrete-encased.

M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 033000 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

N. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.

O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
4. Where conduits are subject to earth movement by settlement or frost.

P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
3. Where conduits penetrate coolers or freezers.

Q. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

R. Provide grounding and bonding in accordance with Section 260526.

S. Identify conduits in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 260533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Boxes for hazardous (classified) locations.

E. Floor boxes.

F. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 078400 - Firestopping.

C. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

D. Section 260526 - Grounding and Bonding for Electrical Systems.

E. Section 260529 - Hangers and Supports for Electrical Systems.

F. Section 260533.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

G. Section .

H. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

I. Section 262726 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.
   3. Poke-through assemblies.
   4. Access floor boxes.
   5. Additional requirements for locating boxes for wiring devices.

J. Section 262813 - Fuses: Spare fuse cabinets.

K. Section 271000 - Structured Cabling: Additional requirements for communications systems outlet boxes.

L. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.
I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
C. Samples:
1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
   4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
   5. Use suitable concrete type boxes where flush-mounted in concrete.
   6. Use suitable masonry type boxes where flush-mounted in masonry walls.
   7. Use raised covers suitable for the type of wall construction and device configuration where required.
   8. Use shallow boxes where required by the type of wall construction.
   9. Do not use "through-wall" boxes designed for access from both sides of wall.

10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
12. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
13. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
14. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
15. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Communications Systems Outlets: Comply with Section 271000.
16. Wall Plates: Comply with Section 262726.
17. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
    c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
    d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
    e. Thomas & Betts Corporation: www.tnb.com/#sle.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
    c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
    d. Substitutions: See Section 016000 - Product Requirements.

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
1. Manufacturers:
    a. Hubbell Incorporated: www.hubbell.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.

F. Floor Boxes:
   1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
   2. Manufacturer: Same as manufacturer of floor box service fittings.

G. Underground Boxes/Enclosures:
   1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
   2. Size: As indicated on drawings.
   3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
   4. Provide logo on cover to indicate type of service.
   5. Applications:
      a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
      b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
      c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
   6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
      a. Manufacturers:
         1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
         2) MacLean Highline: www.macleanhighline.com/#sle.
         3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
         4) Substitutions: See Section 016000 - Product Requirements.
      b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
      b. Communications Systems Outlets: Comply with Section 271000.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
   9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
      b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
   10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
   11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
      a. Concealed above accessible suspended ceilings.
      b. Within joists in areas with no ceiling.
      c. Electrical rooms.
      d. Mechanical equipment rooms.

I. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide required seismic controls in accordance with Section .
   3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
   4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
   5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
   1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.

2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

M. Install boxes as required to preserve insulation integrity.

N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

O. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
2. Flush-mount enclosures located in concrete or paved areas.
3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
4. Provide cast-in-place concrete collar constructed in accordance with Section 033000, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

P. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

R. Close unused box openings.

S. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

T. Provide grounding and bonding in accordance with Section 260526.

U. Identify boxes in accordance with Section 260553.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 260548
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.

C. Vibration-isolated equipment support bases.

D. Vibration isolators.

E. External seismic snubber assemblies.

F. Seismic restraint systems.

1.02 RELATED REQUIREMENTS

A. Section 014533 - Code-Required Special Inspections and Procedures.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

D. Section 260529 - Hangers and Supports for Electrical Systems.

1.03 DEFINITIONS

A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. conduit, cable tray).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.

E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.

F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.

G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).

I. MFMA-4 - Metal Framing Standards Publication; 2004.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
      b. Coordinate the work with other trades to accommodate relative positioning of essential and non-essential components in consideration of seismic interaction.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities.
   2. Seismic Controls: Include seismic load capacities.

D. Certification for seismically qualified equipment; identify basis for certification.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Evidence of qualifications for seismic controls designer.

G. Evidence of qualifications for manufacturer.

H. Manufacturer’s detailed field testing and inspection procedures.

I. Field quality control test reports.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

D. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
   1. Designer may be employed by the manufacturer of the seismic restraint products.

E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
   1. Select vibration isolators to provide required static deflection.
   2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
   3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
   4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
   5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2 inch operating clearance beneath base unless otherwise indicated.

D. Equipment Isolation:
   1. Transformers:
      a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
      b. Floor-Mounted Transformers, Non-Seismic Applications: Use resilent material isolator pads, resilient material isolator mounts, or open (unhoused) spring isolators.
      c. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
      d. Suspended Transformers, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
      e. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
      f. Wall-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator mounts.
      g. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.

h. Minimum Static Deflection:
1) Transformers Mounted on Grade-Level Slabs: 0.25 inch deflection unless otherwise indicated.
2) Transformers Mounted at Above-Grade Levels: 0.5 inch deflection unless otherwise indicated.

E. Conduit Isolation:
1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
a. Minimum Length: 3 feet unless otherwise indicated.
2. Vibration Isolators:
a. Provide vibration isolators for conduit supports:
1) Located within 50 feet of connected vibration-isolated equipment where flexible connection to equipment is not possible.
2) For conduits over 2 inch trade size located below or within 50 feet of noise-sensitive areas indicated.
b. Minimum Static Deflection:
1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
2) Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
c. Suspended Conduits, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
d. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
e. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g. walls, floors) arranged to prevent vibration transmission to structure.

2.02 SEISMIC CONTROL REQUIREMENTS

A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.

B. Seismic Design Criteria: As indicated on drawings.

C. Seismic Qualification of Equipment:
1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.

D. Premanufactured Modular Electrical Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.

E. Seismic Restraints:

1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
2. Seismic Restraint Exemptions:
    a. Exemptions for Seismic Design Category C:
        1) Electrical components where either of the following apply:
            (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
            (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
    b. Exemptions for Seismic Design Category D, E, and F:
        1) Discrete electrical components that are positively attached to the structure where either of the following apply:
            (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (Ip) is 1.0.
            (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
    c. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
        1) Raceways with component importance factor (Ip) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
            (a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
            (b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
            (c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
            (d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.
        2) Conduits less than 2-1/2 inch trade size.
    d. Lighting Exemptions, All Seismic Design Categories:
        1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
        2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.
3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
    a. ASHRAE (HVACA).

b. FEMA 413.
c. FEMA E-74.
d. SMACNA (SRM).

4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:
   a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
6. External Seismic Snubber Assemblies:
   a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
   b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
7. Seismic Restraint Systems:
   a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
   b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
   c. Use only one restraint system type for a given electrical component or distributed system (e.g. conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
   d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
   e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
   f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
   g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
   h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
   i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
   j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.

F. Seismic Attachments:
1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.

4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
    a. Increase size of pad as required to comply with anchor requirements.
    b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

G. Seismic Interactions:
1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
    a. Relative displacements at connections between components, including distributed systems (e.g. conduit, cable tray); do not exceed load limits for equipment utility connections.
    b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
    c. Design displacements at seismic separations.
    d. Anticipated drifts between floors.

2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
    a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
    b. Mason Industries: www.mason-ind.com/#sle.
    c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

C. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.

2.04 VIBRATION ISOLATORS

A. Manufacturers:
   1. Vibration Isolators:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
   2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:
   1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
   2. Spring Elements for Spring Isolators:
      a. Color code or otherwise identify springs to indicate load capacity.
      b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
      c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
      d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
      e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
      f. Selected to function without undue stress or overloading.
   3. Seismic Snubbing Elements for Seismic Isolators:
      a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
      b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

C. Vibration Isolators for Non-Seismic Applications:
   1. Resilient Material Isolator Pads:
      a. Description: Single or multiple layer pads utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material.
      b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
      c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
   2. Resilient Material Isolator Mounts, Non-Seismic:
      a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material; fail-safe type.
   3. Open (Unhoused) Spring Isolators:
      a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
      b. Bottom Load Plate: Non-skid molded elastomeric isolator material or steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
      c. Furnished with integral leveling device for positioning and securing supported equipment.
   4. Housed Spring Isolators:
      a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
      b. Furnished with integral elastomeric snubbing elements, non-adjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.

c. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
d. Furnished with integral leveling device for positioning and securing supported equipment.

5. Restrained Spring Isolators, Non-Seismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
   b. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

D. Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g. neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
   b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:

a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:
1. External Seismic Snubber Assemblies:
a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
b. Mason Industries: www.mason-ind.com/#sle.
c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.
3. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

C. Seismic Snubbing Elements:
1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.06 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:
1. Seismic Restraint Systems:
a. Eaton Corporation: www.eaton.com/#sle.
b. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
c. Mason Industries: www.mason-ind.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.
3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:
1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.

3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Secure fasteners according to manufacturer's recommended torque settings.

E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
   a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
   a. Position equipment at operating height; provide temporary blocking as required.

b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.

3. Isolator Hangers:
a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Clean debris from beneath vibration-isolated equipment that could cause short circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

G. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
a. Size in accordance with seismic design to meet anchor requirements.
b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
b. Install restraints within permissible angles in accordance with seismic design.
c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
d. Install cable restraints for vibration-isolated components slightly slack to prevent short circuiting of isolation.
e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.
B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Provide services of a manufacturer's authorized representative for vibration isolation systems and seismic controls to observe installation and assist in inspection and testing. Include manufacturer's detailed testing and inspection procedures and field reports with submittals.

D. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify required clearance beneath vibration-isolated equipment support bases.
   3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Seismic Controls:
   1. Verify snubbing element air gaps.

F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 ATTACHMENTS

A. Statement of special inspections.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Underground warning tape.
F. Floor marking tape.
G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 099113 - Exterior Painting.
B. Section 099123 - Interior Painting.
C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
D. Section 260536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
E. Section 260573 - Power System Studies: Arc flash hazard warning labels.
F. Section 262300 - Low-Voltage Switchgear: Factory-installed mimic bus.
G. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
H. Section 263100 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.
I. Section 271000 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Samples:
   1. Identification Nameplates: One of each type and color specified.
   2. Warning Signs and Labels: One of each type and legend specified.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchgear:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Use identification nameplate to identify main and tie devices.
         5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
         6) See Section 262300 for factory-installed mimic bus.
      b. Switchboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.

4) Use identification nameplate to identify main overcurrent protective device.
5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

c. Panelboards:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

d. Transformers:
1) Identify kVA rating.
2) Identify voltage and phase for primary and secondary.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify load(s) served. Include location when not within sight of equipment.

e. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

f. Enclosed Contactors:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
4) Identify coil voltage.
5) Identify load(s) and associated circuits controlled. Include location.

g. Centralized Emergency Lighting Inverters:
1) Identify input and output voltage and phase.
2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
3) Identify load(s) served. Include location.

h. Electricity Meters:
1) Identify load(s) metered.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.

3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.

4. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.

5. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
7. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
8. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
9. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
10. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
    a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 099123 and 099113.
11. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    a. Service equipment.
    b. Elevator control panels.
    c. Industrial machinery.
12. Arc Flash Hazard Warning Labels: Comply with Section 260573.
13. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
14. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
15. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
16. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
2. Identification for Communications Conductors and Cables: Comply with Section 271000.
3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    a. At each source and load connection.
    b. Within boxes when more than one circuit is present.
    c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
    d. In cable tray, at maximum intervals of 20 feet.

5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
6. Use underground warning tape to identify direct buried cables.

D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
   a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
      1) Color Code:
         (a) Emergency Power System: Red.
      2) Field-Painting: Comply with Section 099123 and 099113.
      3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
5. Use underground warning tape to identify underground raceways.
6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.

E. Identification for Cable Tray: Comply with Section 260536.

F. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
   a. Color-Coded Boxes: Field-painted in accordance with Section 099123 and 099113 per the same color code used for raceways.
3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
   a. For exposed boxes in public areas, use only identification labels.
4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

G. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 271000.
2. Wiring Device and Wallplate Finishes: Comply with Section 262726.
3. Factory Pre-Marked Wallplates: Comply with Section 262726.
4. Use identification label to identify fire alarm system devices.
   a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
   a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

H. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

I. Identification for Photovoltaic Systems: Comply with Section 263100

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Manufacturers:
a. Brimar Industries, Inc: www.brimar.com/#sle.
b. Kolbi Pipe Marker Co{CH#275749}: www.kolbipipemarkers.com/#sle.
c. Seton Identification Products: www.seton.com/#sle.
2. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Manufacturers:
a. Brady Corporation: www.bradyid.com/#sle.
b. Brother International Corporation: www.brother-usa.com/#sle.
c. Panduit Corp: www.panduit.com/#sle.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
a. Use only for indoor locations.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
a. System designation where applicable:
1) Emergency Power System: Identify with text "EMERGENCY".
2) Fire Alarm System: Identify with text "FIRE ALARM".
b. Equipment designation or other approved description.
c. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
a. System Designation: 1 inch.
b. Equipment Designation: 1/2 inch.
c. Other Information: 1/4 inch.
d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
5. Color:
a. Normal Power System: White text on black background.

b. Emergency Power System: White text on red background.
c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.
a. Exceptions:
1) Provide white text on red background for general information or operational instructions for emergency systems.
2) Provide white text on red background for general information or operational instructions for fire alarm systems.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

H. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. HellermannTyton: www.hellermanntyton.com/#sle.
3. Panduit Corp: www.panduit.com/#sle.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. Brimar Industries, Inc: www.brimar.com/#sle.
3.
4. Seton Identification Products: www.seton.com/#sle.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:
a. Emergency Power System: Text "EMERGENCY".

F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. Brimar Industries, Inc: www.brimar.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.

B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.

C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.

D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

E. Legend: Type of service, continuously repeated over full length of tape.

F. Color:
1. Tape for Buried Power Lines: Black text on red background.
2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 FLOOR MARKING TAPE

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.

B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.

9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 260573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

B. Section 262100 - Low-Voltage Electrical Service Entrance.
   1. Includes Utility Company contact information.

C. Section 262300 - Low-Voltage Switchgear.

D. Section 262413 - Switchboards.

E. Section 262416 - Panelboards.

F. Section 262813 - Fuses.

G. Section 262816.16 - Enclosed Switches.

H. Section 263323 - Central Battery Equipment.

1.03 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.

B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).

D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.

E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.

F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).

G. NEMA MG 00001 - Motors and Generators; 2024.

H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   2. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.

C. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
   3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Study preparer's qualifications.

C. Field testing agency's qualifications.

D. Study reports, stamped or sealed and signed by study preparer.

E. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
   1. Include characteristic time-current trip curves for protective devices.
   2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
   3. Include documentation of listed series ratings upon request.
   4. Identify modifications made in accordance with studies that:
      a. Can be made at no additional cost to Owner.
      b. As submitted will involve a change to the contract sum.

F. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

G. Site-specific arc flash hazard warning labels.

H. Field quality control reports.

I. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

J. Project Record Documents: Revise studies as required to reflect as-built conditions.
   1. Include hard copies with operation and maintenance data submittals.
   2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
   1. Perform analysis of new electrical distribution system as indicated on drawings.

2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
    a. Known Operating Modes:
        1) Utility as source.

B. General Study Requirements:
1. Comply with NFPA 70.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
        1) Obtain up-to-date information from Utility Company.
        2) Utility Company: See Section 262100 for Utility Company contact information.
    b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
    c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
    d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
    e. Protective Devices:
        1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
        2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
    f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
    g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
    a. Maximum utility fault currents.
    b. Maximum motor contribution.
    c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.

2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
   a. To clarify IEEE 1584 statement that "equipment below 240 V need not be considered unless it involves at least one 125 kVA or larger low-impedance transformer in its immediate power supply" for purposes of studies, study preparer to include equipment rated less than 240 V fed by transformers less than 125 kVA in calculations.
   b. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
   c. For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584 yielding conservative results.
3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
   a. Maximum and minimum utility fault currents.
   b. Maximum and minimum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
   a. Identify date of study and study preparer.
   b. Identify study methodology and software product(s) used.
   c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
   d. Identify base used for per unit values.
   e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
   f. Include conclusions and recommendations.
2. Short-Circuit Study:
   a. For each scenario, identify at each bus location:
      1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      2) Fault point X/R ratio.
      3) Associated equipment short circuit current ratings.
   b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
   a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
   b. For each graph include (where applicable):
      1) Partial single-line diagram identifying the portion of the system illustrated.

2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
3) Conductors: Damage curves.
4) Transformers: Inrush points and damage curves.
5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
6) Motors: Full load current, starting curves, and damage curves.
7) Capacitors: Full load current and damage curves.

c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
2) Include ground fault pickup and delay.
3) Include fuse ratings.
4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.

d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.

4. Arc Flash and Shock Risk Assessment:
a. For each scenario, identify at each bus location:
1) Calculated incident energy and associated working distance.
2) Calculated arc flash boundary.
3) Bolted fault current.
4) Arcing fault current.
5) Clearing time.
6) Arc gap distance.

b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

c. Identify locations where the calculated maximum incident energy exceeds 40 calories per sq cm.

1.07 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
2. Study preparer may be employed by field testing agency.

B. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.

C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
1. Acceptable Software Products:
a. EasyPower LLC: www.easypower.com/#sle.
b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
c. Power Analytics Corporation: www.poweranalytics.com/#sle.
d. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
   1. Materials: Comply with Section 260553.
   2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
      a. Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
      b. Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
      c. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
      d. Include the following information:
         1) Arc flash boundary.
         2) Available incident energy and corresponding working distance.
         3) Site-specific PPE (personnel protective equipment) requirements.
         4) Nominal system voltage.
         5) Limited approach boundary.
         6) Restricted approach boundary.
         7) Equipment identification.
         8) Date calculations were performed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install arc flash warning labels in accordance with Section 260553.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Adjust equipment and protective devices for compliance with studies and recommended settings.

E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.03 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.

1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
2. Provide minimum of eight hours of training.
3. Instructor: Representative of entity performing study.
4. Location: At project site.

3.04 ATTACHMENTS

A. Previous studies.

B. Existing drawings.

END OF SECTION

SECTION 260583
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
B. Section 260533.13 - Conduit for Electrical Systems.
C. Section 260533.16 - Boxes for Electrical Systems.
D. Section 262726 - Wiring Devices.
E. Section 262816.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.
B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
B. Products: Listed, classified, and labeled as suitable for the purpose intended.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 262726.

D. Flexible Conduit: As specified in Section 260533.13.

E. Wire and Cable: As specified in Section 260519.

F. Boxes: As specified in Section 260533.16.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.
B. Outdoor motion sensors.
C. Time switches.
D. In-wall time switches.
E. In-wall interval timers.
F. Outdoor photo controls.
G. Daylighting controls.
H. Lighting contactors.
I. Control accessories.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.
B. Section 260529 - Hangers and Supports for Electrical Systems
C. Section 260533.16 - Boxes for Electrical Systems.
D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 260573 - Power System Studies.
F. Section : Devices for manual control of lighting, including .
    1. Includes finish requirements for wall controls specified in this section.
    2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.
G. Section 262813 - Fuses.
H. Section 265100 - Interior Lighting.
I. Section 265561 - Theatrical Lighting: Controls for stage lighting units.
J. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2020.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.

H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).

I. NEMA IA 10039 - Control Circuit and Pilot Devices; 2025.

J. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.

M. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

N. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

O. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

P. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

Q. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

R. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field Quality Control Reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include detailed information on device programming and setup.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: Five percent of total quantity installed for each type, but not less than two of each type.
3. Indicating Lights: Two of each different type.

H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.

D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
3. Sensor Switch Inc: www.sensorswitch.com/#sle.
4. WattStopper: www.wattstopper.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.
6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
14. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
15. Wireless Sensors:
    a. RF Range: 30 feet through typical construction materials.
    b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
    c. Power: Battery-operated with minimum ten-year battery life.

C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
    c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
    d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
    f. Provide selectable audible alert to notify occupant of impending load turn-off.
    g. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
    h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.
2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
    b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
    d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
    e. Provide field adjustable dimming preset for occupied state.
    f. Provide fade-to-off operation to notify occupant of impending load turn-off.
    g. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

E. Ceiling Mounted Occupancy Sensors:
   1. All Ceiling Mounted Occupancy Sensors:
      a. Description: Low profile occupancy sensors designed for ceiling installation.
      b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
      c. Provide field selectable setting for disabling LED motion detector visual indicator.
      d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
      e. Finish: White unless otherwise indicated.
   2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
         1) Products:
   3. Ultrasonic Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
   4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
   5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.

F. Directional Occupancy Sensors:
   1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
      a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
      b. Provide field selectable setting for disabling LED motion detector visual indicator.
      c. Finish: White unless otherwise indicated.
   2. Passive Infrared (PIR) Directional Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.

G. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.

H. Power Packs for Low Voltage Occupancy Sensors:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
   2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
   3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating: As required to control the load indicated on drawings.

I. Power Packs for Wireless Occupancy Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Rating: As required to control the load indicated on drawings.

2.03 OUTDOOR MOTION SENSORS

A. Manufacturers:
1. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
2. Lithonia Lighting: www.lithonia.com/#sle.
3. WattStopper: www.wattstopper.com/#sle.

B. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

C. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

D. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

E. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

F. Integral Photocell: For dusk to dawn operation.

G. Manual Override: Activated by switching power off to unit and then back on.

H. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

I. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

2.04 TIME SWITCHES

2.05 IN-WALL TIME SWITCHES

2.06 IN-WALL INTERVAL TIMERS

2.07 OUTDOOR PHOTO CONTROLS

A. Stem-Mounted Outdoor Photo Controls:
1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
2. Housing: Weatherproof, impact resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

B. Manufacturers:

1. Hubbell Control Solutions: www.hubbell.com/hubbellcontrolsolutions/en/#sle.
2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
3. Sensor Switch Inc: www.sensorswitch.com/#sle.
4. WattStopper: www.wattstopper.com/#sle.

C. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

D. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
1. Sensor Type: Filtered silicon photo diode.
2. Sensor Range:
   a. Indoor Photo Sensors: 5 to 100 footcandles.
   b. Outdoor Photo Sensors: 5 to 250 footcandles.
   c. Atrium Photo Sensors: 200 to 2,500 footcandles.
   d. Skylight Photo Sensors: 1,000 to 6,000 footcandles.
   e. Open Loop Photo Sensors: 3 to 6,000 footcandles.
3. Finish: White unless otherwise indicated.
4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
5. Wireless Daylighting Control Photo Sensors:
   a. RF Range: 30 feet through typical construction materials.
   b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
   c. Power: Battery-operated with minimum ten-year battery life.
   d. Products:
      1) Lutron Radio Powr Savr Wireless Sensors; www.lutron.com/#sle.

E. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

F. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
3. Control Capability:
   a. Single Zone Switching Modules: Capable of controlling one programmable channel.
   b. Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.

G. Daylighting Control Switching Modules for Wireless Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless photo sensors for switching of line voltage loads in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
3. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
4. Control Capability: Capable of controlling one programmable channel.

5. Input Supply Voltage: Dual rated for 120/277 V ac.

H. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
   1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
   2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
   3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
   4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.

I. Daylighting Control Dimming Modules for Wireless Sensors:
   1. Description: Plenum rated control unit compatible with specified wireless photo sensors and with specified dimming ballasts, for continuous dimming of compatible dimming ballasts in response to changes in measured light levels according to selected settings.
   2. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
   3. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
   4. Control Capability: Capable of controlling up to 32 ballasts with up to two separately programmable daylighting zones.

J. Power Packs for Low Voltage Daylighting Control Modules:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
   2. Input Supply Voltage: Dual rated for 120/277 V ac.
   3. Load Ratings: As required to control the load indicated on drawings.

K. Accessories:
   1. Where indicated, provide compatible accessory wall switches for manual override control.
   2. Where indicated, provide compatible accessory wireless controls for manual override control.
      a. Products:
         1) Lutron Pico Wireless Controls; www.lutron.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
   1. Mounting Heights: Unless otherwise indicated, as follows:
      a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
      b. In-Wall Time Switches: 48 inches above finished floor.
      c. In-Wall Interval Timers: 48 inches above finished floor.
   2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.

G. Provide required supports in accordance with Section 260529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Identify lighting control devices in accordance with Section 260553.

J. Occupancy Sensor Locations:
   1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
   2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

K. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

M. Daylighting Control Photo Sensor Locations:
   1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
   2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
   3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

N. Combination Enclosed Lighting Contactors:
   1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

O. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

P. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

Q. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

A. See Section 019113 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
4. Location: At project site.

END OF SECTION

SECTION 262100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
C. Section 260526 - Grounding and Bonding for Electrical Systems.
D. Section 260529 - Hangers and Supports for Electrical Systems.
E. Section 260533.13 - Conduit for Electrical Systems.
F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
G. Section 262300 - Low-Voltage Switchgear: Service entrance equipment.
H. Section 262413 - Switchboards: Service entrance equipment.
I. Section 262416 - Panelboards: Service entrance equipment.
J. Section 262713 - Electricity Metering: Non-utility electrical metering.
K. Section 262816.16 - Enclosed Switches: Service entrance equipment.
L. Section 263100 - Photovoltaic Collectors: Photovoltaic system for interconnection with normal utility electrical supply.
M. Section 264300 - Surge Protective Devices: Service entrance surge protective devices.
N. Section 312316 - Excavation.
O. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
P. Section 312323 - Fill: Bedding and backfilling.
Q. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 PRICE AND PAYMENT PROCEDURES

A. Allowances:
   1. See Section 012100 - Allowances, for allowances affecting this section.
   2. Include cash allowance for Utility Company charges associated with providing service.
B. Unit Prices:
   1. See Section 012200 - Unit Prices, for additional unit price requirements.
   2. Primary:
      a. Basis of Measurement: By the lineal foot, for each configuration.
      b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
   3. Secondary:
      a. Basis of Measurement: By the lineal foot, for each configuration.

b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.

4. Transformer Pad/Vault:
   a. Basis of Measurement: Per unit, for each type.
   b. Basis of Payment: Includes purchase, delivery, and installation.

1.04 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.05 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.06 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
   1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.07 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.08 QUALITY ASSURANCE

A. Comply with the following:
   1. IEEE C2 (National Electrical Safety Code).
   2. NFPA 70 (National Electrical Code).

3. The requirements of the Utility Company.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: As indicated on drawings.

D. Division of Responsibility: As indicated on drawings.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment components in accordance with Section 260529.

E. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.

F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

3.04 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 262413
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section .
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 262100 - Low-Voltage Electrical Service Entrance.
   1. Includes Utility Company contact information.

H. Section 262300 - Low-Voltage Switchgear.

I. Section 262513 - Low-Voltage Busways.

J. Section 262813 - Fuses: Fuses for fusible switches.
   1. Includes requirements for spare fuses and spare fuse cabinets.

K. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.

E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

F. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).

G. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.

H. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.

I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

N. UL 891 - Switchboards; Current Edition, Including All Revisions.

O. UL 977 - Fused Power-Circuit Devices; Current Edition, Including All Revisions.

P. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the electrical outage time with the school district for crossover of power when the new switchboard is installed. Do not discionnect power from the school without written authorization.Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
3. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
6. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
3. Obtain Utility Company approval of switchboard prior to fabrication.
4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.
3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
4. Include documentation of listed series ratings upon request.
5. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.

F. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Field Quality Control Test Reports.

I. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.

J. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Enclosure Keys: Two of each different key.
3. Electronic Trip Circuit Breakers: Provide one portable test set.
4. Drawout Devices:
   a. Handles Necessary for Racking of Devices: One for each electrical room containing switchgear with drawout devices.
   b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout devices.
   c. Portable Lifting Devices: One for each electrical room containing switchboards with drawout devices and no integral top rail-mounted lifting device.
   d. Removable Covers: One for blocking each different opening size when device is temporarily removed from its compartment.
5. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards:
   1. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

B. Products by Siemens Industry are not permitted.

C. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

D. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SWITCHBOARDS

A. Switchboard shall be provided with weatherproof enclosure suitable for outdoor location as required.

B. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

E. Front-Connected Switchboards:
   1. Main Device(s): Individually-mounted.
   2. Feeder Devices: Panel/group-mounted.
   3. Arrangement: Front accessible only (not rear accessible), rear aligned.
   4. Gutter Access: Bolted covers.

F. Service Entrance Switchboards:
   1. Listed and labeled as suitable for use as service equipment according to UL 869A.
   2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
   3. Comply with Utility Company requirements for electrical service.

4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
5. See Section 262100 for additional requirements.

G. Switchboards With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 262513.

H. Switchboards With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).

I. Switchboards With Drawout Devices: Provide integral top rail-mounted lifting device where indicated.

J. Seismic Qualification: Provide switchboards and associated components suitable for application under the seismic design criteria specified in Section where required. Include certification of compliance with submittals.

K. Service Conditions:
1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
a. Altitude: Less than 6,600 feet.
b. Ambient Temperature:
1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
2) Switchboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

L. Short Circuit Current Rating:
1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
3. Minimum Rating: 65,000 rms symmetrical amperes.
4. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
5. Label equipment utilizing series ratings as required by NFPA 70.

M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

N. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

O. Bussing: Sized in accordance with UL 891 temperature rise requirements.
1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
4. Phase and Neutral Bus Material: Aluminum.
5. Ground Bus Material: Aluminum.

P. Conductor Terminations: Suitable for use with the conductors to be installed.

1. Line Conductor Terminations:
   a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   b. Main and Neutral Lug Type: Mechanical.
2. Load Conductor Terminations:
   a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   b. Lug Type:
      1) Provide mechanical lugs unless otherwise indicated.
      2) Provide compression lugs where indicated.

Q. Enclosures:
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
   b. Outdoor Locations: Type 3R.
2. Finish: Manufacturer's standard unless otherwise indicated.
3. Enclosure Space Heaters:
   a. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
   b. Heater Control: Thermostat.
   c. Heater Power Source: Provide connection to transformer factory-installed in switchboard or suitable external branch circuit as indicated or as required.
4. Outdoor Enclosures:
   a. Enclosure Type: Non-walk-in type unless otherwise indicated.
   b. Color: Manufacturer's standard.
   c. Access Doors: Lockable, with all locks keyed alike.
   d. Walk-in Enclosure Features:
      1) Personnel Doors: Open to exterior; equipped with panic hardware.
      2) Aisle lighting, with switch at each access door.
      3) GFCI duplex convenience receptacle.

R. Future Provisions:
1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.

S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list switchboards as a complete assembly including surge protective device.

T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
   a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
   b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
   c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

V. Instrument Transformers:
1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Devices:
1. Fusible Switches:
a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA BS 31047, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
b. Fuse Clips: As required to accept indicated fuses.
1) Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
2. Fused Power-Circuit Devices:
a. Description: Quick-make, quick-break, dead-front bolted-pressure contact switches and high-pressure butt contact switches listed and labeled as complying with UL 977; ratings, configurations, and features as indicated on the drawings.
b. Bolted-Pressure Contact Switches: Devices with additional pressure or clamping action provided at both ends of switch blades when blades are in the fully closed position.
c. High-Pressure Butt Contact Switches: Devices with butt-type contacts and spring-charged mechanism.
d. Minimum Short Circuit Current Rating: 200,000 rms symmetrical amperes when protected by Class L fuses.
e. Fuse Clips: As required to accept Class L fuses.
f. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
g. Provide the following features and accessories where indicated or where required to complete installation:
1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating switch position.
3) Blown fuse protection and indication.

B. Circuit Breakers:
1. Interrupting Capacity:
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

2. Molded Case Circuit Breakers:
   a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
      1) Provide thermal magnetic circuit breakers unless otherwise indicated.
      2) Provide electronic trip circuit breakers where indicated.
   b. Minimum Interrupting Capacity:
      1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      2) 14,000 rms symmetrical amperes at 480 VAC.
   c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
      1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
      2) Provide interchangeable trip units where indicated.
   d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
      1) Provide the following field-adjustable trip response settings:
         (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
         (b) Long time delay.
         (c) Short time pickup and delay.
         (d) Instantaneous pickup.
         (e) Ground fault pickup and delay where ground fault protection is indicated.
      2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
      3) Provide communication capability where indicated: Compatible with system indicated.
   e. Provide the following circuit breaker types where indicated:
      1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
      2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
   f. Provide the following features and accessories where indicated or where required to complete installation:
      1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
      2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
      3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
      4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
      5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

3. Insulated Case Circuit Breakers:
   a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
   b. Operation:
      1) Provide manually operated circuit breakers unless otherwise indicated.
      2) Provide electrically operated circuit breakers where indicated.
      3) Pad-Lock Provision: For preventing circuit breaker closing operation.
   c. Construction:
      1) Provide fixed-mount circuit breakers unless otherwise indicated.
      2) Provide drawout circuit breakers where indicated.
   d. Drawout Circuit Breakers:
      1) Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
      2) Provide safety interlock to prevent racking of circuit breaker while in the ON position.
      3) Pad-Lock Provision: For preventing circuit breaker drawout operation.
   e. Minimum Interrupting Capacity:
      1) 42,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      2) 65,000 rms symmetrical amperes at 480 VAC.
   f. Trip Units: Solid state, microprocessor-based, true rms sensing.
      1) Provide the following field-adjustable trip response settings:
         (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
         (b) Long time delay.
         (c) Short time pickup and delay.
         (d) Instantaneous pickup.
         (e) Ground fault pickup and delay where ground fault protection is indicated.
      2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
      3) Provide communication capability where indicated: Compatible with system indicated.
   g. Provide the following circuit breaker types where indicated:
      1) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
   h. Provide the following features and accessories where indicated or where required to complete installation:
      1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
      2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
      3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
      4) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.04 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
   1. Dielectric tests.
   2. Mechanical operation tests.
   3. Grounding of instrument transformer cases test.
   4. Electrical operation and control wiring tests, including polarity and sequence tests.
   5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.

E. Provide required support and attachment in accordance with Section .

F. Provide required seismic controls in accordance with Section .

G. Install switchboards plumb and level.

H. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.

I. Provide grounding and bonding in accordance with Section 260526.

J. Install all field-installed devices, components, and accessories.

K. Provide fuses complying with Section 262813 for fusible switches as indicated.

L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

M. Set field-adjustable circuit breaker tripping function settings as indicated.

N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

O. Provide filler plates to cover unused spaces in switchboards.

P. Identify switchboards in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.

E. Inspect and test in accordance with NETA ATS, except Section 4.

F. Perform inspections and tests listed in NETA ATS, Section 7.1.

G. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

H. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

I. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
   1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

J. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

K. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

L. Test shunt trips to verify proper operation.

M. Correct deficiencies and replace damaged or defective switchboards or associated components.

N. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

C. Repair scratched or marred surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

3.07 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 262713
ELECTRICITY METERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment for Owner electricity metering:
   1. Single circuit electricity meters.
   2. Multi-circuit electricity meters.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260533.16 - Boxes for Electrical Systems: Cabinets and enclosures for metering system components.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262100 - Low-Voltage Electrical Service Entrance: Requirements for Utility Company electricity metering.

F. Section 262300 - Low-Voltage Switchgear: For interface with meters specified in this section.

G. Section 262413 - Switchboards: For interface with meters specified in this section.

H. Section 262416 - Panelboards: For interface with meters specified in this section.

I. Section 262813 - Fuses.
   1. Includes requirements for spare fuses and spare fuse cabinets.

1.03 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2022.

B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes; 2022.

C. IEC 62053-21 - Electricity Metering Equipment - Particular Requirements - Part 21: Static Meters for AC Active Energy (Classes 0,5, 1 and 2); 2020.

D. IEC 62053-22 - Electricity Metering Equipment - Particular Requirements - Part 22: Static Meters for AC Active Energy (Classes 0,1S,0,2S and 0,5S); 2020.

E. IEC 62053-23 - Electricity Metering Equipment - Particular Requirements - Part 23: Static Meters for Reactive Energy (Classes 2 and 3); 2020.

F. IEEE 1459 - IEEE Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions; 2025, with Errata.

G. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

I. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

J. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.
   2. Coordinate the work with other installers to provide communication lines required for electricity metering system interface.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss electricity metering system interface requirements.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.

C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field Quality Control Test Reports.

F. Project Record Documents: Record actual installed locations of meters and final equipment settings.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.
   3. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electricity Meters - Basis of Design: Veris Industries as indicated under product description below;

B. Electricity Meters - Other Acceptable Manufacturers:
   1. Veris Industries; E5x Series Enhanced Power and Energy Meter:
   2. Same as manufacturer of electrical distribution equipment used for this project.
      a. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

C. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

D. Source Limitations: Furnish electricity meters produced by a single manufacturer and obtained from a single supplier.

2.02 EQUIPMENT FOR OWNER ELECTRICITY METERING

A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.

D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.

E. Enclosures:
   1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 260533.16.
   2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R or Type 4.
   3. Provide lockable door(s) for outdoor locations.
   4. Finish: Manufacturer's standard unless otherwise indicated.

F. Instrument Transformers:
   1. Comply with IEEE C57.13, where applicable.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

G. Interface with Other Work:

1. Interface with electrical power monitoring system.
2. Interface with building automation system.

2.03 SINGLE CIRCUIT ELECTRICITY METERS

A. Single Circuit Electricity Meter - Basis of Design: Veris Industries; E5x Series Enhanced Power and Energy Meter with LCD screen interface; 5-year warranty; utilizes voltage mode CTs that do not require terminal shorting blocks; compatible with solid-core, split-core, and rope CTs.
   1. Accuracy:
      a. Real/Active Power/Energy: Revenue grade; plus/minus 0.2 percent, complying with ANSI C12.20 accuracy and IEC 62053-22, Class 0.2S.
      b. Reactive Power/Energy: Plus/minus 2.0 percent, complying with IEC 62053-23, Class 2.
   2. Measured Parameters:
      a. Real/active energy (kWh); per phase and total of all phases.
      b. Reactive energy (kVARh) and apparent energy (kVAh); total of all phases.
      c. Net present demand over a user-specified interval (block or sliding window); real/active power (kW), reactive power (kVAR), and apparent power (kVA).
      d. Maximum (peak) demand intervals; real/active power (kW), reactive power (kVAR), and apparent power (kVA).
      e. Real/active power (kW), reactive power (kVAR), and apparent power (kVA); per phase and total of all phases.
      f. Models Available with Bi-directional Energy Measurements:
         1) Real/active energy (kWh) and apparent energy (kVAh); imported (from the grid), exported (to the grid), and signed net total.
         2) Reactive energy (kVARh); imported (from the grid) and exported (to the grid), per quadrant as defined by IEEE 1459.
         3) Maximum demand; real/active power (kW), reactive power (kVAR), and apparent power (kVA); imported (from the grid) and exported (to the grid).
      g. Current; per phase and average of all phases.
      h. Voltage; line-to-line and line-to-neutral; per phase and average of all phases.
      i. Power factor; per phase and average of all phases.
      j. Frequency.
   3. Models Available with Data Logging: Logs and retains in non-volatile memory up to 5760 measurement records at time intervals determined by Demand Interval duration setting (up to 60 days of readings at 15 minute intervals).
   4. Alarm capability, with configurable setpoints.
      a. Low power factor.
      b. Current over range.
      c. Voltage over range.
      d. Frequency out of range.
      e. Models available with pulse output overrun.
   5. Models Available with Pulse Contact Accumulator Input(s): Up to two; user-configurable to support measurement of other related energy values (gas, water, steam, etc.) using pulse-output transducers.
   6. Outputs:
      a. Models Available with Phase Loss Alarm Output: One; user-configurable phase loss threshold.
      b. Models Available with Pulse Output(s): Up to two.
   7. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
      a. Models available with Serial Communications:

1) RS-485, 2-wire; support for Modbus RTU protocol.
2) RS-485, 2-wire; support for BACnet MS/TP protocol.
3) LON FT, 2-wire; support for LonTalk protocol.

2.04 MULTI-CIRCUIT ELECTRICITY METERS

A. Multi-Circuit Electricity Meter - Basis of Design: Veris Industries; E3x Series Panelboard Monitoring System; 5-year warranty; utilizes voltage mode CTs that do not require shorting terminal blocks.
   1. Metering Capacity: As indicated or as required for circuits to be monitored (configurations available for monitoring up to 84 branch circuits, two 3-phase main devices, and two neutrals with one meter).
   2. Accuracy:
      a. Real/Active Power/Energy (for models that measure this parameter): Revenue grade; plus/minus 1.0 percent (including branch CTs); complying with ANSI C12.1 and IEC 62053-21, Class 1.
      b. Voltage (for models that measure this parameter): Plus/minus 0.5 percent.
      c. Current: Plus/minus 0.5 percent.
   3. Measured Parameters at Main Device:
      a. Current; per phase and average of all phases.
      b. Maximum current; per phase and maximum average of all phases.
      c. Current demand; per phase and average of all phases.
      d. Maximum current demand; per phase and maximum average of all phases.
      e. Models available with measurements for:
         1) Current phase angle.
         2) Real/active energy (kWh); per phase and total of all phases.
         3) Snapshot of total energy as of the completion of the most recent demand interval; per phase and total of all phases.
         4) Real/active power (kW); per phase and total of all phases; available signed to indicate whether energy is being imported or exported.
         5) Apparent power (kVA); per phase and total of all phases.
         6) Power factor; per phase and total, based on three-phase breaker rotation, signed, to indicate leading or lagging current.
         7) Voltage, line-to-line and line-to neutral; per phase and average of all phases.
         8) Voltage phase angle.
         9) Frequency; phase A.
   4. Measured Parameters at Branch Circuits:
      a. Current; per branch and average of all phases for multi-phase logical circuits.
      b. Maximum current; per branch and maximum average of all phases for multi-phase logical circuits.
      c. Current demand; per branch and average of all phases for multi-phase logical circuits.
      d. Maximum current demand; per branch and maximum average of all phases for multi-phase logical circuits.
      e. Models available with measurements for:
         1) Current phase angle.
         2) Real/active power (kW); per branch and total of all phases for multi-phase logical circuits; available signed to indicate whether energy is being imported or exported.
         3) Real/active power (kW) demand; per branch and total of all phases for multi-phase logical circuits.

4) Real/active power (kW) demand maximum; per branch and total of all phases for multi-phase logical circuits.
5) Real/active energy (kWh); per branch and total of all phases for multi-phase logical circuits.
6) Snapshot of total energy as of the completion of the most recent demand interval; per branch and total of all phases for multi-phase logical circuits.
7) Apparent power (kVA); per branch and total of all phases for multi-phase logical circuits.
8) Power factor; per branch and average of all phases for multi-phase logical circuits, signed to indicate leading or lagging current.

5. Alarm capability, with configurable setpoints.
   a. Current over/under range.
   b. Models available with voltage over/under range.
6. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
   a. Models Available with Serial Communications:
      1) RS-485, 2-wire or 4-wire; support for Modbus RTU protocol.
      2) RS-485, 2-wire; support for Modbus RTU and BACnet MS/TP protocols.
   b. Models Available with Ethernet Communications:
      1) Without RJ-45 10/100 Mbit; requires Modbus TCP Gateway; support for Modbus TCP protocol.
      2) With RJ-45 10/100 Mbit; support for Modbus TCP, BACnet IP, and SNMP protocols.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive meters.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).
B. Install products in accordance with manufacturer's instructions.
C. Provide required support and attachment components in accordance with Section 260529.
D. Provide grounding and bonding in accordance with Section 260526.
E. Provide fuses complying with Section 262813 as required.
F. Identify meters and associated wiring in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.
B. Inspect and test in accordance with NETA ATS, except Section 4.
C. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

E. Correct deficiencies and replace damaged or defective metering system components.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 ADJUSTING

A. Program system parameters according to requirements of Owner.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's authorized representative.
   4. Location: At project site.

3.07 PROTECTION

A. Protect installed system components from subsequent construction operations.

END OF SECTION

SECTION 262813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 262413 - Switchboards: Fusible switches.

C. Section 262416 - Panelboards: Fusible switches.

D. Section 262419 - Motor-Control Centers: Fusible switches.

E. Section 262513 - Low-Voltage Busways: Fusible switches.

F. Section 262816.16 - Enclosed Switches: Fusible switches.

G. Section 262913 - Enclosed Controllers: Fusible switches.

H. Section 263100 - Photovoltaic Collectors: Additional requirements for photovoltaic fuses.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
    a. Fusible Switches for Switchboards: See Section 262413.
    b. Fusible Switches for Panelboards: See Section 262416.
    c. Fusible Switches for Motor Control Centers: See Section 262419.

d. Fusible Switches for Busway: See Section 262501.
e. Fusible Enclosed Switches: See Section 262816.16.
f. Fusible Switches for Enclosed Motor Controllers: See Section 262913.

2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
1. Spare Fuse Cabinet: Include dimensions.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Fuses: One set(s) of three for each type and size installed.
3. Fuse Pullers: One set(s) compatible with each type and size installed.
4. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

2.02 APPLICATIONS

A. Service Entrance:
1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:
1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C. General Purpose Branch Circuits: Class RK1, time-delay.

D. Individual Motor Branch Circuits: Class RK1, time-delay.

E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

F. Primary Protection for Control Transformers: Class CC, time-delay.

2.03 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.
B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
C. Provide fuses of the same type, rating, and manufacturer within the same switch.
D. Comply with UL 248-1.
E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
F. Voltage Rating: Suitable for circuit voltage.
G. Class R Fuses: Comply with UL 248-12.
H. Class L Fuses: Comply with UL 248-10.
I. Class CC Fuses: Comply with UL 248-4.

2.04 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.
B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
C. Install spare fuse cabinet where indicated.
D. Identify spare fuse cabinet in accordance with Section 260553.

END OF SECTION

SECTION 262816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.
B. Section 260529 - Hangers and Supports for Electrical Systems.
C. Section .
D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
E. Section 260573 - Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.
F. Section 262813 - Fuses.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

G. Project Record Documents: Record actual locations of enclosed switches.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

B. General Electric Company: www.geindustrial.com/#sle.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

B. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section where required. Include certification of compliance with submittals.

D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

E. Horsepower Rating: Suitable for connected load.

F. Voltage Rating: Suitable for circuit voltage.

G. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Minimum Ratings:
      a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
      b. General Duty Single Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
      c. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
      d. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.

H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

I. Provide with switch blade contact position that is visible when the cover is open.

J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

K. Conductor Terminations: Suitable for use with the conductors to be installed.

L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

N. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
   a. Indoor Clean, Dry Locations: Type 1.
   b. Outdoor Locations: Type 3R.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

P. Heavy Duty Switches:
1. Comply with NEMA BS 31047.
2. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Provide compression lugs where indicated.
   c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
   a. Provide means for locking handle in the ON position where indicated.

Q. General Duty Switches:
1. Conductor Terminations:
   a. Provide mechanical lugs.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Provide externally operable handle with means for locking in the OFF position, capable of accepting two padlocks.

R. Provide the following features and accessories where indicated or where required to complete installation:
1. Hubs: As required for environment type; sized to accept conduits to be installed.
2. Integral fuse pullers.
3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
4. Viewing Window: Positioned over switch blades for visual confirmation of contact position with door closed.
5. Interlocked Receptacle: Integral pre-wired three phase, three wire, grounded type receptacle interlocked with switch mechanism to prevent insertion or removal of plug with switch in the ON position and to prevent switch from being placed in the ON position without matching plug inserted. Provide receptacle configuration as required to accept plug as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section .

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 260526.

H. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Identify enclosed switches in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 264300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for service entrance locations.

B. Surge protective devices for distribution locations.

C. Surge protective devices for branch panelboard locations.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 262300 - Low-Voltage Switchgear.

C. Section 262413 - Switchboards.

D. Section 262416 - Panelboards.

E. Section 262419 - Motor-Control Centers.

F. Section 262513 - Low-Voltage Busways.

1.03 ABBREVIATIONS AND ACRONYMS

A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.

B. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.

C. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.

F. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
   1. UL 1449.
   2. UL 1283 (for Type 2 SPDs).

E. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

G. Project Record Documents: Record actual connections and locations of surge protective devices.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Field-installed, Externally Mounted Surge Protective Devices - Other Acceptable Manufacturers:
   1. Schneider Electric; Square D Brand Surgelogic Products; _____: www.surgelogic.com/#sle.

B. Factory-installed, Internally Mounted Surge Protective Devices:

1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

C. Substitutions: See Section 016000 - Product Requirements.

D. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Enclosure Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
1. Indoor clean, dry locations: Type 1.
2. Outdoor locations: Type 3R.

C. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

D. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.

E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.

F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 or Type 2.

C. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.

D. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

E. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.

F. Repetitive Surge Current Capacity: Not less than 3,500 impulses.

G. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.05 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

B. List and label as complying with UL 1449, Type 1 or Type 2.

C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.

D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.

E. Repetitive Surge Current Capacity: Not less than 2,000 impulses.

F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

D. Verify system grounding and bonding is in accordance with Section 260526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.

F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 260526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS Section 7.19.1.

D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 265600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Poles and accessories.

C. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section .

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section .

F. Section 260923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.

G. Section 262726 - Wiring Devices: Receptacles for installation in poles.

H. Section 262813 - Fuses.

I. Section 265100 - Interior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2025).

C. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.

D. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).

E. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

F. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

G. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.

H. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.

I. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.

J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

K. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).

L. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL 1598 - Luminaires; Current Edition, Including All Revisions.

O. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.

P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
   2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.
   3. Provide structural calculations for each pole proposed for substitution.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
      b. Include IES LM-79 test report upon request.
   2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
   3. Lamps: Include rated life and initial and mean lumen output.
   4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

D. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.

E. Samples:
   1. Provide one sample(s) of each specified luminaire where indicated.

F. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

G. Field Quality Control Reports.
   1. Include test report indicating measured illumination levels.

H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

I. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
   3. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
   4. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.
   5. Touch-Up Paint: 2 gallons, to match color of pole finish.

K. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
   1. LED Tape - General Requirements:
      a. Listed.
      b. Designed for field cutting in accordance with listing.
      c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
   2. White LED Tape:
      a. Color Rendering Index (CRI): Not less than 90.

J. Exposed Hardware: Stainless steel.

2.03 LED DRIVERS

A. Ballasts/Drivers - General Requirements:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.04 POLES

A. All Poles:
   1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
   2. Structural Design Criteria:
      a. Comply with AASHTO LTS.
      b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
   3. Material: Steel, unless otherwise indicated.
   4. Shape: Square straight, unless otherwise indicated.
   5. Finish: Match luminaire finish, unless otherwise indicated.
   6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.

7. Unless otherwise indicated, provide with the following features/accessories:
   a. Top cap.
   b. Anchor bolts with leveling nuts or leveling shims.
   c. Anchor base cover.
   d. Provision for pole-mounted weatherproof GFI receptacle where indicated.
   e. Hinged base.

B. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.05 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires in accordance with NECA/IESNA 501.

E. Provide required support and attachment in accordance with Section .

F. Provide required seismic controls in accordance with Section .

G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

H. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.

3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
4. Install canopies tight to mounting surface.
5. Unless otherwise indicated, support pendants from swivel hangers.

J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

K. Pole-Mounted Luminaires:
1. Maintain the following minimum clearances:
a. Comply with IEEE C2.
b. Comply with utility company requirements.
2. Foundation-Mounted Poles:
a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 033000.
1) Install anchor bolts plumb per template furnished by pole manufacturer.
2) Position conduits to enter pole shaft.
b. Install foundations plumb.
c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
d. Tighten anchor bolt nuts to manufacturer's recommended torque.
e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
f. Install anchor base covers or anchor bolt covers as indicated.
3. Embedded Poles: Install poles plumb as indicated.
4. Grounding:
a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
b. Provide supplementary ground rod electrode as specified in Section 260526 at each pole bonded to grounding system as indicated.
5. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
6. Install non-breakaway in-line fuse holders and fuses complying with Section 262813 in pole handhole or transformer base for each ungrounded conductor.
7. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 262726 in designated poles.

L. Install accessories furnished with each luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

E. Measure illumination levels at night with calibrated meters to verify conformance with performance requirements. Record test results in written report to be included with submittals.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.06 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

3.09 ATTACHMENTS

A. Luminaire schedule.

B. Luminaire cut sheets.

END OF SECTION

SECTION 27 00 00
COMMUNICATIONS ADMINISTRATION

PART 1 GENERAL

1.01 SUMMARY

A. The work outlined in this specification section is the general administrative overview for all communications systems installed under Division 27 and Division 28.

1.02 SCOPE

A. Submittals

B. Contractor Installation Shop Drawings

C. Warranty, Testing, and Commissioning

D. Contractor Record Closeout Documents

1.03 RELATED REQUIREMENTS

A. Division 27, Communications

1. Division 27 13 00 – Communications Backbone Cabling

1.04 CODES AND STANDARDS

A. The installed system shall confirm to all California State Codes

1. 2022 California Building Code (CBC)

2. 2022 California Electrical Code (CEC)

3. 2022 California Fire Code (CFC)

4. All equipment connected to the Fire Alarm system shall have California State Fire Marshall listing(s).

B. National Codes

1. 2022 NFPA 70 – National Electrical Code

2. 2022 NFPA 72 – National Fire Alarm Code

3. 2022 NFPA 101 – Life Safety Code

4. Americans with Disabilities Act (ADA)

5. Local building codes

C. All requirements by the authority having jurisdiction (AHJ)

D. Telecommunications Industry Association Standards (TIA)

a. TIA 526-7: Single Mode Fiber Standards

b. TIA 526-17: Multi Mode Fiber Standards

c. TIA-568-D.1: Commercial Building Telecommunications Cabling Standards.

d. TIA-568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

e. TIA-569-E: Telecommunications Pathways and Spaces.

f. TIA-606-C: Administration Standard for Telecommunications Infrastructure.

g. TIA-607-D: Generic Telecommunications Bonding and Grounding (Earthing) Requirements for Customer Premises.

E. Audio-Visual and Integrated Experience Association (AVIXA)

a. A102.01.2017: Audio Coverage Uniformity in Listener Areas (ACU)

b. 10:2013 Audio-Visual System Performance Verification

c. F501.01:2015: Cable Labeling for Audio-Visual Systems

d. V201.01: Projected Image System Contrast Ratio

e. F502.02:2018: Rack Building for Audio-Visual Systems

f. A103.01: Sound System Spectral Balance

g. A104.01: Sound System Dynamic Range

PART 2 PRODUCTS

2.01 N/A

PART 3 EXECUTION

3.01 SUBMITTALS

A. Products Material Submittal:

1. Product data and manufacturer’s installation instructions for information, communications, and technology systems electronically in PDF and XLS format, as required. The PDF shall include bookmarks for each section of the submittal.

2. A Microsoft Excel spreadsheet listing each item submitted as a separate row. The spreadsheet shall, at a minimum, contain the following columns:

a. Submittal #,

b. Item # (tied to PDF cut sheet)

c. Spec section submitted

d. Drawing sheet referenced

e. Manufacturer

f. Part number

g. Description

B. Products Material substitutions

1. If the Contractor desires to use any other brand or manufacturer of equal quality and utility to that specified, they shall make application to the District/Architect/Engineer in writing, and shall submit samples, if requested. Such application constitutes a recommendation that the Contractor:

a. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.

b. Will provide the same warranty for equal as for specified product.

c. Will coordinate installation and make other changes, which may be required for work to be complete in all respects.

d. Waives claims for additional costs, which may subsequently become apparent.

e. The Architect/Designer/Engineer will determine whether or not the proposed material is equal in quality and utility to the material specified, and their decision shall be final.

f. Requests for equal materials will only be considered when offered by the Contractor as required by this section

C. Whenever in the Contract Documents any materials, products, processes, or articles are indicated or specified by the name brand of the manufacturer, or by patent or proprietary names, such specifications shall be deemed to be a measure of quality and utility or a standard and shall be deemed to be followed by the words, “or equal.” It is the intent of this article to comply with Public Contract Code Section 3400.

3.02 CONTRACTOR INSTALLATION SHOP DRAWINGS

A. Contractor installation “Shop Drawings” requirements

1. The Contractor Installation Shop Drawings represent the level of system design to be provided to the District/Architect/Engineer. Contractor shall provide all additional system design work required, including:

a. Conduit layout and sizing.

b. Wire and cable layout and sizing.

c. Point-to-point wiring and equipment hook-up information.

d. Equipment mounting details.

1) Design of equipment cabinets, including front rack elevations with accurate equipment rack unit spacing and equipment schedules.

2) MDF / IDF room wall elevations for all systems, junction boxes, wall mounted equipment, power outlets etc., mounted on each wall.

3) MDF / IDF room top view to show placement of equipment racks or cabinets, including required 36” clearance from mounted equipment.

e. Other detailed design work required.

f. Contractor’s design shall conform to all applicable codes and ordinances. All electrical design, including the sizing and placement of conduit, raceways and conductors, shall be in accordance with NFPA 70: National Electrical Code, current version, unless local codes establish more stringent requirements.

g. Contractor’s design work is subject to review and approval by the District/Architect/Engineer, Project Construction Manager.

2. It shall be understood that the drawings, details, and one-lines provided with the design package are diagrammatic and/or performance based. Data presented on design drawings are as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification, of all dimensions, routing, etc., by the contractor is required.

3. Drawings are provided to show the intent of the design and specification and to assist the contractor in submitting a bid. Contractor is directed to make field surveys as part of his work prior to submitting systems installation shop drawings. The contractor shall make allowance in the proposal to cover whatever work is required to comply with the intent of the design and provide a fully functioning complete, operable, and integrated system.

4. In case of doubt of work intended, it is the responsibility of the Contractor to request instructions from the District/Architect/Engineer prior to bid. The contractor shall be responsible for installing a complete, operable, integrated and functioning system to the Districts satisfaction.

5. Installation of the systems shall not be started until detailed contractor furnished shop drawings (in AutoCAD 2020 or similar professional drawing format) and product submittals have been approved by the designer and/or architect and if (a. Applicable, approved by the Division of the State Architect).

6. Any and all design and/or installation discrepancies, change orders, (including labor, materials, and shipping) incurred without contractor shop drawings or after contractor shop drawings have been approved shall be the sole responsibility of the contractor.

7. Any work performed without approved contractor furnished shop drawings and submittals shall not be allowed. If work performed prior to approve shop drawings, contractor will do so at their own risk.

3.03 WARRANTY, TESTING, AND COMMISSIONING

A. Warranty:

1. All components, parts, and installation supplied by the contractor shall be guaranteed against defects in materials and workmanship for one (1) year from date of Notice of Completion or system acceptance, whichever falls later. Labor to repair, reprogram, or replace components shall be furnished by the contractor at no charge during the warranty period.

2. All warranty work of a minor nature shall be performed during hours when site and/or buildings are not occupied, Monday through Friday. Major warranty work, defined as, affecting more than 15% of the system, causing complete operator workstation or server failure, or work involving life safety shall be responded to within four (4) hours. Major warranty work shall be performed regardless of normal work hours or days until corrected.

3. All fiber optic data installs shall carry a Limited Lifetime warranty. This will require the contractor to certify their installers to the manufactures guidelines and submit their certifications with bid documents for the project.

4. Copper (Cat6/Cat6A) network cabling installs for this project shall carry a Limited Lifetime warranty. This will require the contractor to certify their installers to the manufactures guidelines and submit their certifications with bid documents for the project.

3.04 CONTRACTOR RECORD CLOSEOUT DOCUMENTS

A. The Contractor shall provide, at the completion of the project, Project Record Documents and furnish to the District one (1) Electronic Copy set of record drawings. The Contractor Record Closeout Documents shall be prepared in such a manner that each ASI, RFI, CCD, PCO is noted and clouded on the Contractor Record Closeout Documents.

B. The Contractor shall provide an electronic copy of the field redline drawings in PDF format.

C. The electronic Contractor Record Closeout Documents shall follow the following standards:

1. Delivered as an electronic set of documents on a CD-R or a memory stick clearly labeled with Job Number, Bid Number and Name of Project.

2. Drawing standards, such as line-types, line-weights, fonts and symbols shall be consistent with the bid set documents.

3. Include text “Record Drawing” or “As Built” on all sheets.

4. Include all revision deltas and clouds on all sheets.

5. AutoCAD files shall adhere to the following standards:

    a. Full drawing package in AutoCAD (AutoCAD 2020 or most current version), executable .dwg format

    b. Include all fonts and plotting line-weights

    c. Include all cross references

D. The Contractor shall prepare and provide a complete Electronic Cable Book (PDF format), submitted on CD or electronically, as documentation. This cable book shall consist of the following with each section bookmarked within the PDF file:

1. Title of project

2. Index page detailing the sections

3. Site plans (Record set redlined drawings on original full-size bid set plans, hard and soft copy)

4. The drawings shall depict, at a minimum, the following conditions:

    a. Division 27 systems as applicable

E. Final inspection will not be made until drawings are received and approved. Record Drawings shall include “As-Built” one-line and wiring diagrams, with terminations identified, wire color coding schedule, pull box locations, and conduit routing plans.

F. Warranty certificates and documentation.

    a. One (1) Year workmanship warranty

    b. Limited Lifetime manufacturer warranty for Fiber Optic plant.

    c. Limited Lifetime manufacturer warranty for Cat6/Cat6A copper plant.

END OF SECTION

SECTION 27 13 00
COMMUNICATION BACKBONE CABLING

PART 1 – GENERAL

1.01 SUMMARY

A. This section specifies equipment, accessories, materials, installation, configuration and testing requirements for a complete and operable Communications Backbone Cabling system. The system shall provide highly reliable and high-performance data communication from main distribution frame (MDF) to each intermediate distribution frame (IDF) or end points requiring fiber optic cabling.

1.02 SCOPE

A. The work will include but not be limited to the following objectives:

1. For new construction – provide, coordinate, and install all required components and accessories as outlined in the design documents for a complete and operable system.

2. For existing construction – provide, coordinate, and install all components and accessories as outlined in the design documents to modify the existing system while maintaining compliance and to seamlessly integrate the new components into the existing campus' system.

3. Labor and Materials: The Contractor shall provide and pay for all labor, materials, equipment, tools, utilities, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution, operation and completion of the Work.

4. The Contractor shall furnish and install all new conduit/raceway and wire as indicated on the project drawings and/or as required to provide a turn-key system to the District.

5. The Contractor shall terminate all strands of fiber at each fiber enclosure. All cables shall be installed with a minimum 10' service loops at MDF/IDF locations. Fiber will be terminated using LC type connectors.

6. Service loops shall be secured to backboard or rear of cabinet using a pre-manufactured fiber optic wheel with Velcro straps. If installed at rear of cabinet, the wheel shall be placed at a height that will not interfere with equipment to be installed in the cabinet.

7. If applicable, existing systems shall remain operable until new systems are accepted and approved by the District or its representative.

8. The contractor shall complete all required project closeout documentation in a timely fashion.

9. Testing of fiber and connections to insure a complete and operable end-to-end data connection using ANSI/TIA 568-C and ANSI/TIA/526-7 testing guidelines for multi-mode fiber.

10. Fiber installs to carry Leviton Limited Lifetime warranty (see Division 27 05 00 for requirements)

B. VOICE COPPER BACKBONE- This work relates only to sites where the District has not activated a Voice over IP platform or if special circumstances requires an analog copper connection such as a fax machine, intercom connection tie-in, HVAC controller, etc. The work will include but not be limited to the following objectives:

1. MPOE

a. Backbone feeder cables shall be at a minimum Category 5, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 8 pairs.

b. All pairs are to be terminated as follows:

1) At the MPOE end, on 66-blocks.

2) At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

2. Buildings requiring an analog fax connection

a. Backbone feeder cables shall be at a minimum Category 5, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 4 pairs.

b. All pairs are to be terminated as follows:

1) At the IDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

2) At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

3. Buildings requiring an analog tie-in to the intercommunications head end unit.

a. Backbone feeder cables shall be at a minimum Category 5 SHIELDED cable, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 4 pairs.

b. All pairs are to be terminated as follows:

1) At the IDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

2) At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount quickport box.

1.03 REQUIREMENTS

A. Division 01 00 00 – General Requirements

B. Division 27 00 00 - Communication

1.04 INDUSTRY GUIDELINES AND STANDARDS

A. ANSI/TIA-568-1.D: Commercial Building Telecommunications Cabling Standard.

B. ANSI/TIA -568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standard.

C. ANSI/TIA -568-3.D: Optical Fiber Cabling Components Standard.

D. ANSI/TIA/EIA-569-D: Telecommunications Pathways and Spaces.

E. ANSI/TIA -568-0.D: Measurement of Optical Power Loss of Installed Fiber Optic Cable Plant

F. ANSI/TIA -598-D: Optical Fiber Cable Color Coding.

G. ANSI/TIA -606-C: Administration Standard for Telecommunications Infrastructure.

H. ANSI/TIA -607-C: Generic Telecommunications Bonding and Grounding (Earthing) Requirements for Customer Premises.

I. ANSI/TIA -758-B: Customer-Owned Outside Plant Telecommunications Infrastructure Standard.

J. Fiber optic cable, wire and connectors shall be installed as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended functions. As such, all of the following: National Fire Code (NFPA), National Electrical Code (NEC), California Electrical Code (CEC), California Building Code (CBC) & Local Codes shall be followed.

1.05 QUALIFICATIONS

A. The contractor shall possess a California C7 or C10 license.

B. The Contractor or Subcontractor shall be Leviton certified to provide and install cable plant with 5 years documented experience.

C. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.

1.06 REFERENCES

A. See Division 27 00 00.

1.07 SYSTEM REQUIREMENTS

A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing data cable plan system.

1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS

A. See section 27 00 00 for requirements.

1.09 SUBMITTALS

A. See section 27 00 00 for requirements.

PART 2 – PRODUCTS

2.01 DATA FIBER BACKBONE

A. See Appendix at the end of this document for pre-approved materials.

B. All products shall be new and unused and shall be of manufacturer's current and standard production.

C. Contractor shall confirm all equipment part numbers with the District prior to ordering equipment and updating submittals as required.

D. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.

E. Product Availability

1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.

2.02 CONDUIT AND RACEWAY

A. See division 27 05 00 for conduit and raceway requirements.

2.03 WIRE AND CABLE

A. Refer to Appendix A for Pre-approved manufacturers and part numbers.

B. Provide all new wire and cable required to install systems as indicated on design documents.

C. Fiber optic cables shall be tight buffered laser optimized, 6 strands for Elementary Schools and 12 strands for Middle and High school. Any cable shall not exceed a .30" diameter.

1. Fiber optic cable shall have a minimum effective modal bandwidth of 3500 MHz/Km. See Appendix at the end of this document for approved material.

D. Fiber Optic connectors for multi-mode shall be industry standard LC type connectors. See Appendix at the end of this document for approved material.

E. MDF rack mount fiber optic enclosures (LIU) shall be as outlined in Appendix at the end of this document and completely loaded with Ceramic ferrule Duplex LC Packs unless listed otherwise in drawings and details or approved equal.

F. Furnish one (1)-meter LC to LC duplex cross over fiber patch cord for every two terminations at IDF locations and one (2) meter LC to LC duplex cross over fiber patch cord for every two terminations at MDF location. The patch cords shall have connectors with ceramic ferrules. All patch cords shall be packaged with a factory performance certification report. Verify all lengths before ordering.

2.04 FIBER OPTIC CABLE MANAGEMENT RING

A. Re-closable ring cable management device. Ring should be 24 inches in diameter for Copper Multipair, OSP, or Armored cable, and 12” diameter for Indoor fiber cable.

B. Ring to be mounted on the backboard at the OSP fiber entrance as indicated. Six hook and loop style loops attached.

C. Approved Products

1. Leviton 24” Velcro fiber spool, 48900-OFR

2. Leviton 12” Velcro fiber spool, 48900-IFR

2.05 PATCH CORDS

A. See section 27 16 00 for requirements

2.06 LOW VOLTAGE ENCLOSURES AND PATHWAYS

A. See section 27 05 00 for additional requirements.

PART 3 – EXECUTION

3.01 ACCEPTABLE INSTALLERS

A. The cable plant system shall only be installed by Contractors who are qualified to install, service and maintain the cable plant system.

B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years’ experience before the Bid Opening Date.

3.02 EXAMINATION

A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the

Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to the District.

B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

3.03 PREPARATION

A. The Contractor shall order all required parts and equipment upon receipt of approved product submittals.

B. The Contractor shall verify the availability of power where required.

3.04 SHOP DRAWINGS

A. See section 27 00 00 for requirements

B. Submit drawings for review and approval by Project Manager.

3.05 INSTALLATION

A. See 27 05 00 for additional routing requirements

B. The cables will be routed to their respective Main Distribution Frame (MDF) or Intermediate Distribution Frame (IDF) utilizing the shortest path possible while maintaining right angles to the building structure.

C. Contractor is required to adhere to the parameters in this section whether or not existing equipment has been placed by Contractor and/or others.

D. Contractor will notify the District if any of the requirements cannot be met prior to bid.

E. Voice copper backbone

1. Terminations shall be T568B configuration unless otherwise specified.

2. Labeling

a. Wiring termination locations shall be labeled to corresponding pairs at the MDF and IDF.

b. Cables shall be labeled no more than 3” back from each end of the termination point with a cable label that matches the patch panel labeling.

c. Contractor will provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure over time.

d. Handwritten labels are not acceptable.

e. Each pair shall have a unique label throughout the site. This would allow a cable management system to track each cable pair.

f. Labeling Scheme

1) Closet labeling: 66-block or surface-mount quickport box shall be labeled with the destination MDF or IDF #, sequential feeder pair number only. The labeling itself shall be in a white background with black lettering.

F. Data Fiber Backbone

1. The District has standardized on materials that provide component quality and maintainability. Refer to the Appendix A at the end of this specification for pre-approved material.

2. Fiber Optics Cable Installation and Testing.

a. Service loops shall be secured to backboard or rear of cabinet using a pre-manufactured fiber optic wheel with Velcro straps. If installed at rear of cabinet, the wheel shall be placed at a height that will not interfere with equipment to be installed in the cabinet.

b. Fiber cables shall be securely mounted to the fiber enclosure using zip ties in at least two locations around the jacket to prevent cable twisting and movement. In addition, the Kevlar or strength member shall be bolted, tied, or securely fastened to the enclosure.

c. Fibers strands shall be neatly organized in the enclosure with individual bundled paths from each cable to the bulkheads in which they are mounted.

d. Fiber strands shall be made to rest in their final position without tension or stress of any kind.

e. All spare optical ports and connectors shall have a dust cap in place to protect from the environment.

f. Contractor shall provide and install blanks in unused spaces of the fiber enclosure.

g. All unused optical ports on the LIU shall have protective covers that prevents dust and particles to enter the port.

3. Fiber Optics Labeling

a. Fiber termination locations shall be labeled to corresponding fiber strands pairs at the MDF and IDF.

b. The labeling scheme shall be submitted by the contractor for District / District representative approval prior to installation.

c. Contractor is expected to provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure over time.

d. Handwritten labels are not acceptable.

e. Labeling requirements

1) Cables shall be labeled approximately 12 inches back from the point where the cable enters the fiber enclosure with a cable label that identifies the origin and destination of the cable.

2) Closet labeling; each connection shall be labeled denoting each strands number, origin and destination.

3) The type (single-mode or multi-mode) of fiber optic cable used shall be clearly labeled on the fiber patch panel per drawn details.

4) Color-coding shall conform to ANSI/TIA specifications.

4. Fiber Optics Testing

a. All optical test equipment shall have current, traceable calibration certification.

b. If fiber is supplied to Contractor by the district shall be tested before installation, while still on the shipping reel, using an optical time domain reflectometer (OTDR). The test results shall be compared to the manufacturers test results. A discrepancy of more than 1 dB on any fiber in either window indicates possible shipping damage and the fiber shall be returned to the supplier. The test results shall be maintained in a file for future reference.

c. All fiber shall be tested after installation according to the Method A procedures described in ANST/TIA-568-C.

d. Power meter test equipment shall produce a machine generated test report containing the minimum of the following test information:

1) Contractor’s Name

2) Operator’s Name

3) Customer’s location

4) Closet Location

5) Cable ID

6) Test Summary – i.e. Pass/Fail

7) Date and Time of test

8) Test Standard

9) Equipment serial numbers

10) Length in Feet

11) Test direction – i.e. MDF to IDF=A-B / IDF to MDF=B-A

12) Wavelength

13) Optical loss in dB

14) Optical loss limit

15) Reference setting

16) Reference setting date and time

(a) (Most bi-directional test sets will meet these criteria providing the operator enters the proper information. Contractor shall notify the project manager before testing if there is any question regarding this requirement)

e. In addition to power meter testing, OTDR testing is to be performed in any location where the fiber is not continuous, i.e. coupled LC connectors (soft splice), fusion splice, and mechanical splice. When testing with an OTDR the contractor shall utilize a test lead or launch cable a minimum of 100 meters in length and a trail test cable a minimum of 100 meters in length. The contractor shall set a marker at the start and end of the tested cable on each test result and the difference in loss between the two markers shall be noted on the test report. The results of these tests (printed OTDR result power meter attenuation results) shall be provided by the installer as documentation of the quality of installation and as a baseline for future troubleshooting. The results shall be compared to the pre-installation test results for significant changes.

f. The multi-mode cable shall comply with maximum individual fiber loss limits in accordance with ANSI/TIA-568-C Multimode, OM4.

g. Aerial fiber cable mounting hardware shall be matched to the all dielectric self-supporting (ADSS) fiber cable exactly and be installed in accordance with mounting hardware and cabling manufacturers specifications.

3.06 WORKMANSHIP

A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship. Contractors unfamiliar with the District's standards shall familiarize themselves with the District's standards and requirements prior to beginning work.

B. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.

C. Perform Work with persons experienced and qualified to produce workmanship specified.

D. Maintain quality control over suppliers and Subcontractors.

E. Quality of workmanship is considered important. The District's Project Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

3.07 CABLE

A. Design, layout, size, and plan new cable runs as required.

B. All wire and cable passing thru metalwork shall be sleeved by an approved grommet or bushing.

C. Conduit/raceway fill shall not exceed 40 percent of interior cross-sectional area.

D. Identify all cables at terminations. Identification shall be made with an approved permanent label, machine generated 1/4" black letters on white tape (Brady or equal.)

E. Underground cable shall be rated for use.

F. Neatly dress and tie all cabling.

3.08 CONDUIT AND RACEWAY INSTALLATION

A. Design, lay-out, size and plan new conduit and raceway systems as required.

B. Install conduit and raceway in accordance with Division 27 05 00 requirements.

3.09 PENETRATIONS, CUTTING AND PATCHING, DEMOLITION, PAINTING

A. A. See section 27 05 00 for requirements

3.10 FIELD QUALITY CONTROL AND TESTING

A. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.

B. Submit the Record Drawings (as-builts) to District for review prior to inspection.

C. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to inspect wiring, devices and system operation.

D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.

E. Notify District when ready to perform a re-inspection of the installation.

3.11 EQUIPMENT INSTALLATION CONFIGURATION AND TESTING

A. See section 27 21 00 for requirements

3.12 AS-BUILT DRAWINGS AND TEST RESULTS

A. See section 27 00 00 for requirements.

APPENDIX-A
(Unless Otherwise Specified on Construction Document Plan Sheets)

PATCH PANEL AND WIRE MANAGEMENT

DESCRIPTION	MANUFACTURER	PART NUMBER
48-Port Snap-in Patch Panel, 2U Wire management bar included	Leviton	49255-D48
Horizontal Cable Management	Leviton	49253-LPM

FIBER / COPPER MATERIAL

DESCRIPTION	MANUFACTURER	PART NUMBER
Leviton 2000i SDX Series fiber housing a) 19” rack mounted units completely loaded with Zirconia Ceramic LC fiber adapter plates	Leviton	1U = 5R1UH-S03 2U = 5R2UH-S06 4U = 5R4UH-S12
Fiber Wall Mount Enclosure	Leviton	5WMNT-01C
Leviton SDF fiber adapter plate	Leviton	5F100-2QL
12-strand OM4 LOMM 50um tight buffered plenum indoor/outdoor rated fiber (no loose tube)	Berk-Tek	PDP012FB3010/F5-I/O-C4(AQU)
4-pair or larger copper feeders		See division 27 15 00

END OF APPENDIX A

END OF SECTION

SECTION 284600
FIRE DETECTION AND ALARM

PART 2 PRODUCTS

1.01 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
   1. Protected Premises: Entire building shown on drawings.
   2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. ADA Standards.
      b. The requirements of the local authority having jurisdiction , which is _____.
      c. Applicable local codes.
      d. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
   3. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
   4. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
   5. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
   6. Fire Command Center: Location indicated on drawings.
   7. Fire Alarm Control Unit: New, located at fire command center.

B. Supervising Stations and Fire Department Connections:
   1. Public Fire Department Notification: By on-premises supervising station.
   2. On-Premises Supervising Station: Existing proprietary station operated by Owner, located at _____.
   3. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.

C. Circuits:
   1. Initiating Device Circuits (IDC): Class B, Style A.
   2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
   3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Power Sources:
   1. Primary: Dedicated branch circuits of the facility power distribution system.
   2. Secondary: Storage batteries.
   3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
   4. Each Computer System: Provide uninterruptible power supply (UPS).

1.02 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:

1.03 COMPONENTS

A. General:
   1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
   2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Initiating Devices:
   1. Addressable Systems:
      a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
      b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.

D. Notification Appliances:

E. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.

F. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

G. Locks and Keys: Deliver keys to Owner.

H. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
   4. Provide extra copy with operation and maintenance data submittal.

END OF SECTION

SECTION 311000
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and grubbing of the site, including the removal of debris, vegetation, foreign objects, concrete slabs and foundations, asphalt paving, portland concrete paving and curbs, site lighting and bases, site walls, area drains and catch basins, unwanted existing underground utilities and drain lines, conduits, trees, and other site construction as indicated and as required for grading the site suitable for constructing the proposed project.

1.02 RELATED REQUIREMENTS

A. Section 312323 - Fill: Material for filling holes, pits, and excavations generated as result of removal operations.

1.03 REFERENCE STANDARDS

A. ANSI A300 Part 6 - Tree, Shrub, and Other Woody Plant Management--Standard Practices (Planting and Transplanting); 2012 (Reapproved 2018).

PART 2 PRODUCTS

2.01 MATERIALS

A. Sedimentation Barrier: See Section 015713 - Temporary Erosion and Sediment Control.

B. Fill Material: Per Section 312323 and as approved by the Geotechnical Engineer.

PART 3 EXECUTION

3.01 PREPARATION

A. Erect barriers, fences, guard rails, enclosures, and shoring to protect personnel, structures, the public, and site improvements and utilities to be maintained intact.

B. Protect and maintain benchmarks and survey control points from disturbance during construction.

C. Locate and clearly flag trees and vegetation to remain or be relocated.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.02 SITE CLEARING

A. Comply with additional requirements specified in Section 017000 - Execution and Closeout Requirements.

B. Fill depressions caused by clearing and grubbing operations with material satisfactory to the geotechnical engineer unless further excavation or earthwork is indicated.

C. Place fill material in horizontal layers in accordance with the recommendations in the project geotechnical report and compact each layer to a density satisfactory to the geotechnical engineer.

3.03 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths is encountered in a manner to prevent intermingling with underlying subsoil or other waste.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.04 EXISTING UTILITIES AND BUILT ELEMENTS

A. Coordinate work with utility companies; notify before starting work and comply with local requirements; obtain required permits.

B. Protect existing utilities, utility structures, and associated appurtenances to remain from damage.

C. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner's Representative not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's Representative written permission.

D. Do not disrupt public utilities without permit from authority having jurisdiction.

E. Protect existing structures and other elements that are not to be removed. Remove unwanted existing utilities as indicated or as uncovered by work, and cap in a manner conforming to Code. Determine status of utility lines encountered that are not shown on the Contract Drawings. If abandoned, remove and dispose of in proper manner.

F. Install temporary erosion and sediment controls according to Section 015713 - Temporary Erosion and Sediment Control.

G. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Check with local jurisdiction for any needed inspection permits.

3.05 CLEARING AND GRUBBING

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by structures, paving, lawns, and planting areas. Remove rootballs and all exposed roots greater than 1/2 inch in diameter.

B. Clear site after relocating vegetation in accordance with ANSI A300 Part 6.

C. Stripped materials may be reused on the site in landscaped areas, provided that they are kept a minimum of 5 feet from flatwork or pavement areas, and are moistured conditioned and compacted in accordance with the Project Geotechnical Engineer's recommendations.

D. Preservation of existing vegetation: The construction schedule shall consider the amount and duration of soil exposed to erosion by wind, rainfall, and vehicle tracking and seek to minimize disturbed soil during the rainy season. A schedule shall be prepared that shows the sequencing of construction activities with installation of maintenance of soil stabilization and sediment control BMPs.

E. Do not remove or damage vegetation beyond limits indicated on drawings.

F. Install substantial, highly visible fences at least 6 feet high to prevent inadvertent damage to vegetation to remain:
   1. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
   2. Around other vegetation to remain within vegetation removal limits.
   3. See Section 015000 for fence construction requirements.

G. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum subsoil disturbance.

3.06 REMOVED VEGETATION PROCESSING

A. Do not burn, bury, landfill, or leave on-site, except as allowed by the Owner.

3.07 SITE IMPROVEMENTS

A. Remove existing above and below grade improvements as indicated and as necessary to facilitate new construction.

B. Demolish and completely remove existing construction as indicated from the site, including subsurface conditions designated to be removed or required to be removed to facilitate the work of the proposed project.
   1. Demolish asphalt, concrete, and masonry in small sections. Continuously wet down debris to prevent creation of dust or fire hazard.
   2. Fragments: Remove from the site asphalt and concrete fragments exceeding 6 inches in maximum dimension.

3.08 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and windblown debris from public and private lands.

END OF SECTION

SECTION 312200
GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough grading.

B. Fine grading.

1.02 RELATED REQUIREMENTS

A. Section 311000 - Site Clearing.

B. Project Geotechnical Report: "Geologic Hazards and Geotechnical Engineering Report" for Elkhorn Elementary School New Classroom Building and Remodeling", prepared by Mid Pacific Engineering (MPE No. 06317-03), dated June 6, 2025.

C. "Supplemental Recommendations Letter" for Elkhorn Elementary School New Classroom Building and Remodeling", prepared by Mid Pacific Engineering (MPE No. 06317-03), dated April 8, 2026.

D. Standard Specifications for Public Works Construction (Greenbook); current edition.

1.03 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with the Standards Specifications for Public Works Construction (Greenbook); current edition.

B. Perform work in accordance with Project Geotechnical Report.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: Per Section 312323 and as approved by the Geotechnical Engineer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify survey bench mark and intended elevations for grading areas are as indicated.

B. Verify the absence of standing or ponding water.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect above- and below-grade utilities to remain.

D. Provide temporary means and methods to remove standing or ponding water from areas prior to grading.

E. Protect site features to remain, including but not limited to bench marks, survey control points, and fences.

3.03 ROUGH GRADING

A. Excavate and fill subgrade material to elevations indicated on plans.

B. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
   1. Remove sod, grass, and any other vegetation before stripping top soil.
   2. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
   3. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
   4. Strip topsoil to depth indicated by the Project Geotechnical Engineer.

C. Horizontally bench existing slopes greater than 1:4.

D. Replace displaced subgrade in accordance with Section 312323.

E. Remove and replace unsuitable materials as specified fill.

3.04 FINE GRADING

A. Scrape and spread subgrade material uniformly smooth and without disruptions as indicated on drawings.

3.05 SOIL REMOVAL

A. Stockpile topsoil to be re-used on site; remove remainder from site.
   1. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water and other erosion control measures.
      a. Limit height of topsoil stockpiles to 72 inches.
      b. Do not stockpile topsoil within plant protection zones.
      c. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or resued.

B. Stockpile subsoil to be re-used on site; remove remainder from site.

C. Soils below building pads should be over-excavated to 5 feet beyond the perimeter of the building, and to a depth equal to the bottoms of proposed foundations or 2 feet below existing site grades (whichever is deeper), and subgrades below excavations and sub-excavations should be prepared as required per Subsection "Site Preparation and Over-Excavation" per the Project Geotechnical Report.

3.06 TOLERANCES

A. Top Surface: Plus or minus 1/2 inch.

3.07 FIELD QUALITY CONTROL

A. Compaction density testing shall be as described in the Project Geotechnical Report and as approved by the Geotechnical Engineer.

3.08 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.
C. Leave site clean and raked, ready to receive work.

END OF SECTION

SECTION 312316
EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for footings, slabs-on-grade, paving, site structures, and utilities within the building.

B. Trenching for utilities outside the buildings.

1.02 RELATED REQUIREMENTS

A. Project Geotechnical report; bore hole locations and findings of subsurface materials.

B. Section 015713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.

C. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring. General requirements for dewatering of excavations and water control.

D. Section 312200 - Grading: Grading.

E. Section 312316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

F. Section 312323 - Fill: Fill materials, backfilling, and compacting.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Protect plants, lawns, rock outcroppings, and other features to remain.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

3.03 EXCAVATING

A. Excavate to accommodate new structures and construction operations.

B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

3.05 PROTECTION

A. Divert surface flow from rains or water discharges from the excavation.

B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.

D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 312316.13
TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

A. Project Geotechnical Report; bore hole locations and findings of subsurface materials.
B. Section 312200 - Grading: Site grading.

1.03 DEFINITIONS

A. Finish Grade (FG) Elevations: Indicated on drawings.
B. Finish Surface (FS) Elevations: Indicated on drawings.
C. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .
B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).
D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2024.
E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)); 2012 (Reapproved 2021).
F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.
G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).
H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).
I. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.
J. Standard Specifications for Public Works Construction (Greenbook); current edition.
K. Project Geotechnical Report.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Samples: 10 pound sample of each type of fill; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.

D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

E. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where allowed by owner.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. As specified in Section 312323 and by the Project Geotechnical Engineer.

2.02 ACCESSORIES

A. Geotextile: See Section 312323.

B. Trace Wire and Detectable Warning Tape: Install detectable warning tape during the installation of proposed utilities on contract drawings. Acid- and alakli-resistant, polyethylene film warning tape manufactured for making and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 5 mils (0.1mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep, colored as follows:
   1. Red: Electric and cathodic protection.
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone, fiber optic, and other communications.
   4. Blue: Potable water and fire protection service systems.
   5. Green: Sewer and storm drainage systems.
   6. Purple: Non-potable reclaimed water.

2.03 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided before delivery to site.

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

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

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Protect plants, lawns, rock outcroppings, and other features to remain.

E. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect.

3.03 TRENCHING

A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches wide enough to allow inspection of installed utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

G. Remove excavated material that is unsuitable for re-use from site.

H. Stockpile excavated material to be re-used in area designated in Section 312200.

I. Remove excess excavated material from site.

J. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

K. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.04 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

A. Backfill to contours and elevations indicated using unfrozen materials.

B. Fill up to subgrade elevations unless otherwise indicated.

C. Employ a placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Correct areas that are over-excavated.
   1. Thrust bearing surfaces: Fill with concrete.
   2. Other areas: Use engineered fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.

G. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
   2. At Landscaped areas: 90 percent of maximum dry density.

H. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

B. Utility Piping and Conduits:
   1. Bedding: Use clean sands or clean crushed rock in accordance with Greenbook requirements and as per the contact drawing trenching details.
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 6 inch lifts to 95 percent of maximum dry density.

3.07 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Tests: As required by the Project Geotechnical Engineer.

3.09 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 312323
FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for paving, site structures, and utilities within the building.

B. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

A. Project Geotechnical report; bore hole locations and findings of subsurface materials.

B. Section 015713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.

C. Section 033000 - Cast-in-Place Concrete.

D. Section 312200 - Grading: Site grading.

E. Section 312316 - Excavation: Removal and handling of soil to be re-used.

F. Section 312316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

1.03 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .

B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2024.

E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)); 2012 (Reapproved 2021).

F. Standard Specifications for Public Works Construction (Greenbook); current edition.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.

D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When fill materials need to be stored on site, locate stockpiles where designated.
   1. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Subsoil excavated on-site.
   1. Free of debris, organics, lumps larger than 3 inches, rocks larger than 1/2 inches, rubble, and debris.
B. Engineered Fill: Conforming to Greenbook Section 200-1.4, and recommendations as stated in the Project's Geotechnical Report.
C. Imported Fill: Well-graded granular soils or aggregates with a Plasticity Index of 15 or less, an Expansion Index of 20 or less, with no particles graded than 3 inches in maximum dimensions, as per the Geotechnical Report requirements.
D. Concrete for Fill: Lean concrete conforming to Greenbook Section 200-4, and recommendations as stated in the Project's Geotechnical Report.
E. Granular Fill: Crushed rock, conforming to Greenbook Section 200-1.2, and recommendations as stated in the Project's Geotechnical Report. Gravel use is acceptable only when used in conjunction with filter fabric.
F. Sand: Conforming to Greenbook Section 200-1.5, and recommendations as stated in the Project's Geotechnical Report.

2.02 ACCESSORIES

A. Geotextile Fabric: Non-biodegradable, woven Mirafi ; 140N manufactured by Mirafi, or approved equal.

2.03 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of soil material.
B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided before delivery to site.
C. If tests indicate materials do not meet specified requirements, change material and retest.
D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.
B. Identify required lines, levels, contours, and datum locations.
C. See Section 312200 for additional requirements.
D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
E. Verify structural ability of unsupported walls to support imposed loads by the fill.
F. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

A. Subgrade below building pads and exerior pavements should be prepared as required per Section "Recommendations", Subsection "Engineered Fill Construction", of the Project Geotechnical Report.

B. Scarify and proof roll subgrade surface to a depth of [12] inches to identify soft spots.

C. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

D. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

E. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Fill up to subgrade elevations unless otherwise indicated.

C. Fill placed below buildings should consist of non-expansive, imported soils, and should extend at least 5 feet beyond outer edge of building foundations and at least 2 feet beyond adjacent exterior pavements as required per Section "Recommendations", Subsection "Engineered FIll Construction", of the Project Geotechnical Report.

D. Employ a placement method that does not disturb or damage other work.

E. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

H. Correct areas that are over-excavated.
   1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 100 percent of maximum dry density.
   2. Other areas: Use engineered fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.

I. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
   2. At landscaped areas: 90 percent of maximum dry density.

J. Reshape and re-compact fills subjected to vehicular traffic.

K. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FILL AT SPECIFIC LOCATIONS

A. Over Buried Utility Piping and Conduits
   1. Refer to Section 312316.13 and the contract drawing trenching details.

3.05 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.

B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Tests: As required by the Project Geotechnical Engineer.

E. Proof roll compacted fill at surfaces that will be under slabs-on-grade and paving.

3.07 CLEANING

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 320190
LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, material, equipment and services required to maintain landscape in a healthy growing condition and in a neat and attractive appearance throughout the maintenance period.

1.02 RELATED REQUIREMENTS

A. Division 32 Section Landscape Irrigation

B. Division 32 Section Landscape Work

1.03 QUALITY ASSURANCE

A. The Maintenance Contractor shall be experienced in horticulture and landscape maintenance, practices and techniques, and shall provide sufficient number of workers with adequate equipment to perform the work during the maintenance period.

1.04 MAINTENANCE PERIOD

A. Continuously maintain the entire project area during the progress of the work and during the ninety (90) calendar-day maintenance period until final acceptance of the project by the Landscape Architect,
   1. Maintenance Period begins after all punchlist and corrective items have been accepted by the Landscape Architect and owner.

B. Maintenance period shall not start until all punch list items are addressed, when all elements of construction, planting and irrigation for the entire project are in accordance with Plans and Specifications. A prime requirement is that all lawn and landscape areas shall be planted and that all lawn areas shall show an even, healthy stand of grass seedlings which shall have been mown twice. If such criteria are met to the satisfaction of the Landscape Architect, a written notification shall be issued to establish the effective beginning date of maintenance period.

C. Any day of improper maintenance, as determined by the Landscape Architect, shall not be credited as an acceptable maintenance period day. The maintenance period shall be extended on a daily basis if the work is not in accordance to the Plans and Specifications. Project shall not be segmented into maintenance areas or phases, unless authorization of the Landscape Architect is obtained.

D. Maintenance shall continue beyond the ninety (90) day maintenance period, as required, until final acceptance is given by the Landscape Architect.

E. Contractor shall provide protection to the project site during the maintenance period.

F. A phased maintenance period will not be accepted.

1.05 GUARANTEE AND REPLACEMENT

A. Guarantee: All plant material and other materials installed under the Contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are as follows:

1. Trees, vines, and shrubs: One Year
2. Groundcover and Turf: One year.

B. Replacement: Any materials found to be dead, missing, declining or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect or owner. All replacement materials and installations shall comply with the Plans and Specifications. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the owner that security on this site needs to be intensified.

C. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the owner shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

1.06 OBSERVATION SCHEDULE

A. Normal progress observations shall be requested by the Contractor from the Landscape Architect as per observations listed in specifications Division 32 Section "Landscape Work."

1.07 FINAL ACCEPTANCE OF THE PROJECT

A. Upon completion of all project work, including maintenance period, the Landscape Architect will, upon proper written request, make an observation to determine final project acceptability. Provide minimum a 14 business day notice for final observation.

B. Where observed work does not comply with the Plans and Specifications, replace rejected work and continue specified maintenance period until reinspected by the Landscape Architect and determined to be acceptable. All replacement materials and installations shall be in accordance with the Plans and Specifications. Remove rejected work and materials immediately from project. Prior to the date of final observation, Contractor shall provide the Landscape Architect with all Record Drawings and close out documents in accordance with the Plans and Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials used shall either conform to Specifications in other sections or shall otherwise be acceptable to the Landscape Architect. The Landscape Architect shall be given a monthly record of all herbicides, insecticides and disease control chemicals used and irrigation scheduled. The amendments listed herein are for Bidding purposes only. The final amendment types and rates shall be determined by the Agronomic Soils Test.

B. Turf maintenance fertilizer: shall be "Best Turf Supreme 16-6-8":
1. 16% nitrogen
2. 6% phosphoric acid
3. 8% potash

C. Slow Release maintenance fertilizer: shall be "Best Superturf 25-5-5 with Polyon" and shall consist of the following percents by weight:
1. 25% nitrogen
2. 5% phosphoric acid
3. 5% potash

PART 3 - EXECUTION

3.01 GENERAL MAINTENANCE

A. General: Proper maintenance, including watering, weeding, mowing, edging, fertilization, rolling of turf, replacement and infill of mulch replacement of jute mesh, infill of settled areas, repairing and protection shall be required until entire project is finally accepted, but in any event for a period of not less than the specified maintenance period after planting.

B. Watering: Thoroughly water to insure vigorous and healthy growth until work is accepted. Water in a manner to prevent erosion due to application of excessive quantities of water. When hand watering use a water wand to break the water force. Supplemental hand water as required to maintain and encourage the proper growth of new and existing plant material.

C. Weeding:
   1. Keep plant basins, turf areas and areas between plants free of weeds. Control weeds with pre-emergent herbicides. If weeds develop, use legally approved herbicides and hand remove. Avoid frequent soil cultivation that destroys shallow roots. Weeding also shall be included in all paved areas including public or private sidewalks.
   2. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.
   3. Apply a final application of pre-emergent herbicide at the end of the maintenance period, just prior to final acceptance.

D. Tree basins in turf areas: Remove turf from around each tree to create a 4'- 0" diameter basin depending on tree size.

E. Pruning
   1. Trees: Prune trees to select and develop permanent scaffold branches; to eliminate narrow V-shaped branch forks that lack strength; to reduce toppling and wind damage by thinning out crowns; to maintain a natural appearance and to balance crown with roots. All trees shall be maintained and pruned in accordance with the accepted practices of the American Society of Consulting Arborists (ASCA). Prune only as directed by the Registered Consulting Arborists and Landscape Architect.
   2. Shrubs: Same objectives as for trees. Shrubs shall not be clipped into balled or boxed forms unless such is required by the landscape plans. All pruning cuts shall be made to lateral branches, buds or flush with the trunk. Stubbing and heading shall not be permitted.
   3. Only skilled workers shall perform pruning work in accordance with standard horticultural pruning practices. Remove from the project all pruned branches and material. Remove and replace any plant material excessively pruned or malformed resulting from improper pruning practices at no additional costs to the owner.
   4. Improperly pruned plant material as determined by the Landscape Architect is to be replaced at no cost to the owner.

F. Staking and Guys: Stakes and guys shall remain in place through the guarantee period and shall be inspected and adjusted to prevent rubbing that causes bark wounds. Remove nursery stake from all trees that are staked with lodgepole stakes per specifications. Provide supplemental staking or guying as required during high wind events to prevent damage to trees. Any damaged tree caused by high winds must be replaced by the contractor at no cost to the owner.

G. Insect, Animal, Rodent and Disease Control: Maintain proper control with legally approved materials as required as part of the Contract.

H. Protection: The Contractor shall maintain protection of the planted areas. Damaged areas shall be repaired or replaced at the Contractor's expense.

I. Trash: Remove trash weekly in all planted areas, pedestrian walkways and parking areas. Maintain all areas free of trash, clippings, and debris at all times.

J. Replacement: As per Guarantee and Replacement Specifications of this Section.

K. Fertilization: Fertilize all planting areas, during and just prior to end of maintenance period with the slow release maintenance fertilizer as indicated in the agronomic soils report.

L. Watering: Planting areas shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy plant material.
   1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.

3.02 LAWN AND TURF MAINTENANCE

A. Mowing and Edging
   1. Initial mowing of turf will commence when the grass has reached a height of two and one-half (2-1/2) inches. The height of cut will be two (2) inches. After initial establishment maintain Bermuda and creeping grasses at 1½" and fescues or rye grass at 2". Mowing will be at least every 4-6 days for the second through fifth cuttings, and at least once per week after that for fescue. Bermuda grass is to be mowed minimum twice a week. Bent grass is to be mowed daily. Turf must be well established and free of bare spots and weeds to the satisfaction of the Landscape Architect prior to final acceptance.
   2. Excess grass clippings shall be picked up and removed from the site and premises. Let turf areas dry out enough so that mower wheels do not skid, tear or mark the lawn. Edges shall be trimmed at 90 degrees to pavement, at least weekly or as needed for neat appearance. Clippings shall be removed from paved and planting areas, etc. and disposed of from the site.

B. Watering: Lawns shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy strands of grass.
   1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.

C. Disease control: Control turf diseases throughout the maintenance period with legally approved fungicides and herbicides. Replace any damaged or infected grass.

D. Weed Control:
   1. Control broad leaf weeds with selective, legally approved herbicides throughout maintenance period.
   2. A final application of selective herbicide shall be applied at the end of the landscape maintenance period, acceptance, just prior to final acceptance.
   3. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.

E. Fertilization:
   1. During maintenance period an application of turf maintenance fertilizer, as specified, shall be made at thirty (30) day intervals from the date of maintenance period start at a rate of five (5) pounds per 1,000 square feet, and as required by the agronomic soils report.
   2. Final application (just prior to final acceptance) shall be made with the slow-release maintenance fertilizer as required by the agronomic soils report.

3. Replacement: At conclusion of maintenance period a final observation of lawn and turf areas shall be made. Remove diseased areas and unhealthy strands of grass from the site; do not bury into the soil. Replant areas with material and in a manner as specified on the Plans and Specifications at no additional cost to the Owner. All grass is to be fully grown with 100% coverage with a suitable thatch layer prior to turnover and final acceptance.

F. Arborist: Provide a written report and recommendations as required by the landscape architect if any plant material is in the sole opinion of the landscape architect, declining, stressed, infested, or otherwise not growing at the anticipated growth rate. The report is to include Agronomic Soils Test Data and recommendations and be provided at no cost to the owner.

3.03 IRRIGATION SYSTEM

A. System Observation: The Contractor shall check all systems for proper operation. Lateral lines shall be flushed out after removing the last sprinkler head or two at each end of the lateral. All heads are to be adjusted as necessary for unimpeded head to head coverage.

B. Valves: Contractor shall set, and verify that all pressure regulating valves to the operating pressure specified on the drawings.

C. Controllers: Set and program automatic controllers for seasonal water requirements. Give the Owner's Representative instructions on how to turn off system in case of emergency.

D. If the irrigation system is designed and specified to be operable from a central irrigation computer controller located off site, or a standard controller on site. The contractor shall demonstrate to Landscape Architect, Owner's Representative and future maintenance contractor that the central irrigation system is fully installed and operational from this off site control system as described and specified. Contractor shall make all adjustments as necessary to insure this operation prior to final acceptance.

E. Contractor shall set up and coordinate training for the Maintenance Contractor (Provider) on the irrigation controller, and pump with the manufactures representative. Maintenance period shall not end, and the project will not be accepted until this training has been completed.

F. Repairs: Repair all damages to irrigation system at the Contractor's expense. Repairs shall be made within twenty-four (24) hours or sooner to prevent damage to site improvements.

3.04 CLEANING

A. During maintenance work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, fertilizer, amendments and / or other material from landscape planting and/or maintenance period.

B. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks on surfaces caused by maintenance or construction vehicles, prior to final acceptance.

END OF SECTION

SECTION 321120
SUBBASE AND AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

1.02 RELATED REQUIREMENTS

A. Section 312200 - Grading.

B. Section 312316.13 - Trenching.

C. Section 312323 - Fill.

1.03 REFERENCE STANDARDS

A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).

B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .

C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012 (Reapproved 2021).

E. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2024.

F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)); 2012 (Reapproved 2021).

G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.

H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).

I. ASTM D3665 - Standard Practice for Random Sampling of Construction Materials; 2024.

J. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).

K. ASTM D5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test; 2020.

L. ASTM D6693/D6693M - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes; 2020.

M. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate Base Course:
   1. Type Class 2 aggregate base, 3/4-inch maximum size : Comply with State of California Highway Department (CALTRANS) standard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

B. Verify substrate has been inspected, and gradients and elevations are correct and dry.

3.02 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting.

B. Do not place aggregate on soft, muddy, or frozen surfaces.

C. Grade excavated and filled substrate; see Section 312200.

D. Backfill and compact trench excavations; see Section 312316.13.

E. Backfill and compact subgrade fill; see Section 312323.

3.03 PLACEMENT

A. Under Bituminous Concrete Paving:
   1. Aggregate Base Compacted Thickness: According to contract drawings.

B. Under Portland Cement Concrete Paving:
   1. Aggregate Base Compacted Thickness: According to contract drawings.

C. Place course in maximum 4 inch layers and roller compact to specified density.

D. Level and contour surfaces to elevations and gradients indicated.

E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

A. Variation From Design Elevation: Within 1/2 inch.

B. Flatness: Maximum variation of 1/2 inch measured with 10 foot straight edge.

C. Scheduled Compacted Thickness: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Subbase Compaction Density Testing: In accordance with ASTM D1556/D1556M, ASTM D2167, or ASTM D6938.

C. Aggregate Base Compaction Density Testing: In accordance with ASTM D1556/D1556M, ASTM D2167, or ASTM D6938.

D. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").

E. Frequency of Tests: In accordance with ASTM D3665.

F. Remove, replace, and retest work that does not meet specified requirements.

G. Proof roll compacted aggregate at surfaces going underneath flexible paving.

3.06 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Stockpile unused materials neat and compact.

C. Remove unused materials and grade areas to prevent standing surface water.

END OF SECTION

SECTION 321216
ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single course bituminous concrete paving.

B. Surface sealer.

1.02 RELATED REQUIREMENTS

A. Section 312200 - Grading: Preparation of site for paving and base.

B. Section 321123 - Aggregate Base Courses: Aggregate base course.

C. Section 321313 - Concrete Paving: Concrete substrate.

D. Section 321313 - Concrete Paving: Concrete curbs.

E. Section 321723 - Pavement Markings

F. Project Geotechnical Report.

1.03 REFERENCE STANDARDS

A. AI MS-2 - Asphalt Mix Design Methods; 2015.

B. AI MS-19 - Basic Asphalt Emulsion Manual; 2008.

C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.

D. ASTM D3549 Standard Test Method for Thickness of Height of Compacted Asphalt Mixture Specimens (2018).

E. ASTM D2950 Standard Test Method of Density of Bituminous Concrete in Place by Nuclear Methods (2020).

F. California Department of Transportation Standard Specifications; current edition.

G. Standard Specifications for Public Works Construction (SSPWC,Greenbook); current edition.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with Standard Specifications for Public Works Construction (SSPWC) and the California Department of Transportation (Caltrans), latest editions and supplements for asphalt paving work.

B. Obtain materials from same source throughout.

1.05 **SUBMITTALS**

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1.06 FIELD CONDITIONS

A. Do not place asphalt when ambient air or base surface temperature is less than 50 degrees Fahrenheit and rising, or surface is wet or frozen.

B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.01 MATERIALS

A. Asphalt Concrete: Type A 1/2-inch hot mix asphalt (HMA) per Caltrans Standard Specifications, Division 39 Asphalt Concrete.

B. Aggregate Base Course: Section 321123.

C. Slurry Seal: Per Caltrans Standard Specifications, Division 37-3 Slurry Seals.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

A. Parking lots including drive aisles and parking spaces:
   1. Type A HMA, 1/2-inch aggregate, PG 64-10 binder.

B. Playgrounds/Hardcourts/Playcourts.
   1. Type A HMA, 1/2-inch aggregate, PG 64-10 binder.

C. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.03 SOURCE QUALITY CONTROL

A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.02 AGGREGATE BASE COURSE

A. See Section 321123.

3.03 PREPARATION - TACK COAT

A. Apply tack coat in accordance with Caltrans Standard Specifications requirements.

B. Apply tack coat to existing pavement including planed surfaces, between hot mix asphalt layers, and to vertical surfaces of curbs, gutters, construction joints and milled pavements.

3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Install work in accordance with Caltrans Standard Specifications.

B. Place asphalt within 24 hours of applying primer or tack coat.

C. Place to a maximum thickness per Caltrans Standard Specifications.

D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.05 SEAL COAT

A. Apply seal coat to asphalt surface course and asphalt curbs in accordance with Caltrans Standard Specifications.

3.06 SLURRY SEAL

A. Apply slurry seal to asphalt surfaces as shown in the contract drawings, and in accordance with Caltrans Standard Specifications.

3.07 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.

C. Variation from True Elevation: Within 1/2 inch.

3.08 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for quality control.

B. Provide final surfaces of uniform texture, conforming to required grades and cross sections.
   1. Test in-place asphalt concrete courses for compliance with requirement for density, thickness, and surface smoothness.
      a. Density:
         1) Field test density of compacted asphalt surface course shall be determined by a properly calibrated nuclear test gage in accordance with ASTM D2950.
      b. Thickness:
         1) Thickness of compacted paving shall conform to ASTM D3549 based on core test.
         2) In-place compacted thicknessess shall conform to the dimensions indicated on the contract drawings. Variation from indicated thicknesses shall not exceed plus-or-minus 1/4-inch.

C. Flood Testing
   1. Flood Test: Before acceptance, all pavements in the presence of the project inspector shall be water tested to ensure proper drainage. The contractor shall provide water for this purpose. The flooding shall be conducted with a water tank truck. Depressions where the water ponds to a depth of more than 1/8-inch shall be filled or the slope corrected to provide proper drainage. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible. No standing water shall remain 1-hour after test.

3.09 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 321313
CONCRETE PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Curbs and gutters.
B. Walks.
C. Stairs and ramps.
D. Mow strips.
E. Wheel stops.
F. Pavement marking paint.
G. Detectable warnings.

1.02 RELATED REQUIREMENTS

A. Divison 00 Section Available Project Information (Geotechnical Report)
B. Division 03 Section Cast-in-Place Concrete
C. Division 05 Section Metal Fabrications
D. Division 05 Section Pipe and Tube Railings.
E. Division 05 Section Decorative Metal Railings
F. Division 31 Section Grading
G. Division 32 Section Architectural Site Concrete
H. Division 32 Section Concrete Paving Joint Sealants
I. Division 32 Section Chain Link Fences and Gates

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, and ground granulated blast-furnace slag, subject to compliance with requirements.

1.04 PREINSTALLATION CONFERENCE

A. Conduct conference at Project site two weeks prior to start of work of this section. Required attendance of all affected installers.
   1. Review methods and procedures related to concrete paving, including but not limited to, the following:
   2. Concrete mixture design
   3. Testing and inspection procedures.
   4. Concrete finishes and finishing.
   5. Cold- and hot-weather concreting procedures.
   6. Curing procedures.
   7. Construction joints.
   8. Forms and form-removal limitations.

9. Reinforcement accessory installation.
10. Concrete repair procedures.
11. Protection of cast-in-place architectural site concrete.
12. Review special testing and inspection procedures.
13. Placement sequence and schedule.
14. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
    a. Contractor's superintendent.
    b. Ready-mix concrete manufacturer.
    c. Concrete paving subcontractor.
    d. District's or Client's Representative
    e. Architect's Representative
    f. Inspector of Record
    g. Provide meeting minutes for pre-installation conference

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, etc.: Indicate compatibility with other materials used.
   2. Stenciling material

B. LEED Submittals:
   1. Product Data for Credit MR credit 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating costs for each product having recycled content.

C. Samples for Initial Selection: For each type of product, finish, ingredient, or admixture requiring color selection.
   1. Submit full range of manufacturer’s standard and custom range of colors and products for review and selection. Provide custom colors on samples as required. Upon selection of color, submit 12”x12” sample of material in the specified color finish for review by Landscape Architect in addition to the specified mock ups.
   2. Stencil Shop Drawing submittal to Architect for approval is required before mock up work for stenciling is to begin.
   3. Wheel Stops: 6 - 7 inches wide in cross section; with fasteners.
   4. Preformed Traffic-Calming Devices: 6 inches long showing cross section; with fasteners.

D. Design Mixtures: Submit proposed mix designs and test data for each class of concrete and for each method of placement.
   1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Chapter 1903A.
   2. Mix designs shall be prepared, stamped and signed by a structural or civil engineer registered in the State of California.
      a. Mix designs shall be reviewed by the Architect (AOR) and Structural Engineer of Record (SEOR).
   3. Identify for each mix design submitted the method by which proportions have been selected.
      a. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength f'c results. Provide gross weight and yield per cubic yard of trial mixes.
      b. Indicate quantity of each ingredient per cubic yard of concrete and percentages.
      c. Indicate type and quantity of admixtures proposed or required.
      d. Indicate water to cement ratio by weight.

e. Measured slump.
f. Measured air content.
g. Provide shrinkage test results.

4. Multiple mix designs or multiple manufacturers shall not be permitted for the same application.

E. Provide maximum 5% fly ash; ground granulated blast-furnace slag, and/or silica fume content as Portland cement replacement in all concrete.

F. Submit proposed alternate design mixtures for review by the Architect and SEOR when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

G. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Shop drawings should include details such as reveals, recessed lights, handrails, or other elements requiring steel coordination.
1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
2. Comply with ACI 315, part B and CRSI requirements.

H. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete if different than layout indicated on plans.
1. Location of construction joints are subject to approval of the Architect.
2. All form seams are to align with construction joints or reveals.

I. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

J. Pavement-Marking Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

K. Stencil Shop Drawings: Indicate size, font, height, length, of each required image or text. Drawings shall reflect a plan, which denotes the location of the stenciled image or text.

L. Qualification Data: For qualified ready-mix concrete manufacturer (batch plant) and installer of detectable warnings.

M. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.

N. Material Certificates: For the following, submit manufacturer data, test results, and technical information for aggregate, sand and cement, submit ½ cubic foot physical sample. For sealant submit manufacturer color standard and custom palette together with physical samples:
1. Cementitious materials.
2. Aggregates and sand.
3. Steel reinforcement and reinforcement accessories.
4. Fiber reinforcement.
5. Admixtures.
6. Curing compounds.
7. Applied finish materials.
8. Bonding agent and epoxy adhesives.
9. Joint fillers.
10. Sealer
11. Sealant.

12. Pigments.

O. Material Test Reports: For each of the following:
   1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

P. Detectable Warning Device Warranty: Submit copies of manufacture's five year warranty for each of these products and manufacturer custom and standard color palette.

Q. Field quality-control reports.
   1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.

R. Minutes of pre-installation conference.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with CBC Chapter 19A.
   1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
   2. Comply with requirements of local, State and other authorities having jurisdiction for work performed within public right-of ways.

B. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.

C. Comply with requirements of local, State and other authorities having jurisdiction for work performed within public right-of ways.

D. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.(Plans and specifications)
   1. ACI 301, "Specifications for Structural Concrete".
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
   3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
   4. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
   5. ACI 305R, "Hot Weather Concreting".
   6. ACI 306.1, "Standard Specification for Cold Weather Concreting".
   7. ACI 318, "Building Code Requirements for Structural Concrete".
   8. ACI 347, "Guide to Formwork for Concrete".
   9. ACI SP-66, "ACI Detailing Manual".
   10. CRSI, "Manual of Standard Practice".
   11. CRSI, "Placing Reinforcing Bars".

E. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of cast-in-place, surface-applied unit-paver-type detectable truncated dome products.

F. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

G. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance.

H. Welding Qualifications: Comply with CBC Chapter 17A.

1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."

I. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

J. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

K. ACI Publications: Comply with ACI 301 unless otherwise indicated.

L. Mockups: Before casting concrete paving, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints (including expansion and saw cut joints), surface finish, texture, color tolerances, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
    a. Paving Modules: Construct at least one 4 ft. x 4 ft. mockup of each color, finish, and mix design of special paving module, including stenciled areas, banding and curbs
    b. Radial Paving Patterns: Construct at least one 180 sq. ft. mockup of curved or radial paving patterns.
    c. Mow Strip: minimum 6’ long for each specified width and color.
    d. Stenciled Letters or Graphics: minimum 4 letters and one full size graphic for each size, font setting and finish. Mock up to be set on concrete pavement or wall matching conditions of final install.
2. Build mockups full-size, matching site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, edges, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated including multiple pour conditions. Mockups should be provided for each finish, color, joint and detail specified.
3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.
4. Demonstrate curing, cleaning, and protecting of cast-in-place concrete paving, finishes, and contraction and expansion joints, as applicable.
5. Mockup Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete and paving.
    a. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
    b. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups maybe required.
    c. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.
6. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mockup onsite for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. prior to Project Completion. If sufficient permanent concrete paving work has been completed, Contractor may submit a written request to Architect to transfer quality control for concrete paving from the accepted mockups to one or more designated portions of the permanent work.
7. Provide written meeting minutes for each mock up review indicating items reviewed, approvals, rejections, connections, or other action items.

1.07 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending, damage, and rust.
   1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
   2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
   3. Avoid damaging applied coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.01 FORMS

A. Formwork: / Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth surfaces.
   1. Set forms to alignment, grade and required dimensions. Formwork shall not deviate more than 1/4 inch from required vertical positions and 1/4 inch from required horizontal positions. Exposed Surfaces: Provide faced plywood panels complying with, or equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints. Provide Medium-Density Overlay (MDO) panels or high density overlay (HDO) panels, with mill-applied release agent and edge sealant. Provide one of the following panels, or comparable substituted product:
      a. Olympic Panel Products, "B-Matte 333 MDO Concrete Form." Overlay Color: Brown.
      b. Pacific Laminate Products, "ProFace MDO." Overlay Color: Black.
      c. Sylvan Products, LLC, "Armor Ply MDO" Overlay Color: Brown.
   2. Hold forms rigidly in place by stakes, clamps, spreaders, and braces at 3 feet on centers, and where required to ensure rigidity.
   3. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
   4. Place joint filler or backer rod on vertical surfaces in contact with concrete paving.
   5. Benders or thin plank forms may be used on curves, grade changes, or curb returns. Back forms for curb returns may be made of ½-inch thick benders cleated together for full depth of the curb.
   6. Keep forms in place until concrete is sufficiently hard to prevent damage to concrete.
   7. Reuse of Forms:
      a. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of surface or edge.
      b. Thoroughly clean and properly coat forms before reuse.
      c. Do not use forms from previous projects.
   8. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.

B. Curved Work: Kerf back of plywood form-facing panels, or use accepted flexible or curved forms for curved work with a radius of 100 feet or less.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
   1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
   2. Form-release agents shall be non-staining and can cause no visual effect to the finish.
   3. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.02 STEEL REINFORCEMENT

A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 60 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.

G. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
   1. Provide two-component "Speed Dowel System" manufactured by Greenstreak.

H. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

I. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

J. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

K. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

L. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

M. Zinc Repair Material: ASTM A 780.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
   1. Portland Cement: ASTM C 150, Type II/V, Type I/II or Type IV, gray, unless white cement is required to achieve colors indicated.
      a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
   1. Comply with CBC section 1903A.
   2. Maximum Coarse-Aggregate Size: 3/8 inch nominal.
      a. Source: Reliance, Vulcan, San Gabriel, or Carrol Canyon
      b. Hard rock mix; no pea gravel will be accepted.
   3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
      a. Source: Reliance, Foster, Corona
      b. Color to be white to light no dark material.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
   1. Products: Subject to compliance with requirements, provide the following(as required):
      a. Meet ASTM C494 requirements
         1) Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
         2) Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
         3) Sika Corporation; Control 40.

2.04 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete. Provide products with not more than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Construction Chemicals, LLC; Confirm.
      b. Conspec by Dayton Superior; Aquafilm.
      c. Nox-Crete Products Group; MONOFILM.

E. Clear, Waterborne, Membrane-Forming Curing Compound (Colored Concrete): Provide products that are acceptable to concrete color pigment manufacturer complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of sealers with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sinak Corporation; The Cure WCE or Lithium Cure 1000.
      b. L. M. Scofield; Cureseal-W.
      c. Butterfield Color; Clear Guard H2O.

F. All curing materials should be dissipating without leaving a shiny, cloudy, or glossy finish. Curing material does not substitute requirement of a sealer.

2.05 STENCIL MATERIALS

A. Stencils: Manufacturer's standard, moisture-resistant paper or reusable plastic stencils, designed for use on plastic concrete.

B. Stencils: Manufacturer's standard, moisture-resistant paper or reusable plastic stencils, designed for use on concrete.

C. Shop drawings for all stencils.

D. Products: Subject to compliance with requirements.

2.06 HARDENERS AND SEALERS

A. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate water-based lithium quartz materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials hsall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide product with 0g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sinak Corporation; Concrete Sealer HLQ 125.
      b. L. M. Scofield; Cureseal-W.
      c. L&M Construction Chemicals, Inc.; Seal Hard.

2.07 AGGREGATE BASE

A. Granular Fill: Class II crushed aggregate per Section 26 of Cal-Trans standards. Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch (9.5-mm), 20 to 10 / 10 to 30 percent passing a No. 100 (0.15-mm) sieve, and at least 0-5 percent passing No. 200 (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.08 RELATED MATERIALS

A. Joint Fillers:
   1. Ceramar by W.R. Meadows. A closed cell isomeric polymer synthetic foam ASTM D 5249, Type 2 .
   2. Deck-O-Foam polyethylene by W.R. Meadows. A closed cell expansion joint fille ASTM D 4819
   3. Asphalt-saturated cellulosic fiber in preformed strips, ASTM D 1751
   4. 1/4" thickness.

B. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. W. R. Meadows, Inc.; “Acry-Lok”.
      b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
      c. Larsen Products Corp., "Weld-Crete".

C. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete, and for anchoring dowels to hardened concrete.

2.09 DETECTABLE WARNING MATERIALS

A. General: All detectable warning systems shall comply with Americans with Disabilities Act (28 CFR Part 36 ADA Standards for Accessible Design, Appendix A, Section 4.29.2 Detectable Warnings on Walking Surfaces), and CBC requirements (Section 11B-24, 11B-705 and others). All detectable warning materials shall have raised truncated domes with a base diameter of nominal 0.90 inch (22.9 mm), tapering to a top diameter of 0.45 inch (11.4 mm),a height of nominal 0.20 inch (5.08 mm), and a center-to-center spacing of 2.35 inches (59.7 mm) nominal. The orientation of the dome pattern for all panels shall be parallel with the panel edges. Detectable warning materials shall visually contrast with surrounding areas.
   1. California Compliance Warranty: All detectable warning systems shall be approved by DSA-AC. If not approved, DSA will accept a written five (5) year product warranty provided by the manufacturer of detectable warning products and directional surfaces. Such warranty shall indicate compliance with architectural standards as published in the current edition of the California Building Standards Code, and also include durability criteria which indicate that the shape, color fastness, confirmation, sound-on-cane acoustic quality, resilience, and attachment will not degrade significantly for at least five (5) years after initial installation. As defined by the State, "not degrade significantly" means that the product maintains at least 90 percent of its approved design characteristics, as determined by the enforcing agency.

B. Concrete Paver Detectable Dome Warning System: Provide standard size precast architectural concrete paving units for installation in sand or mortar beds.
   1. Basis-of Design Product: Provide the following, or comparable substitute product:
      a. Wausau - ADA-2 Truncated dome pavers.
         1) 12 inches by 12 inches, with 2 3/8 inches thickness.
         2) Color A-40 Yellow (Federal Yellow No. 33538)

2.10 PAVEMENT MARKINGS

A. Color: [As indicated].

B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
   1. Color: White, green, unless otherwise indicated. Use for non-accessible striping, directional arrows, numbering, and lettering.
   2. Accessibility Color: Paint accessibility lines and markings blue color equal to Color No. 15090 per Federal Specification 595C.

2.11 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, 3000 to 4000 -psi minimum compressive strength, 5-1/2 to 6 inches high by 6 to 7 inches wide by 48 inches long at singles stalls and 72 to 96 inches long at shared stalls. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
   1. Dowels: Galvanized steel or rebar, 1/2 inch in diameter, 18-inch minimum length.

2.12 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. Proportioning:

a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.
1) Float/Broom Finish: Coarse aggregate 50 percent-50 percent fine aggregate.
c. Total water content shall not exceed 35 gallons per cubic yard of concrete.
d. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
e. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.

3. Prepare compressive strength data for both 7-day and 28-day strengths.
a. The 7-day compressive strength shall be at least 60 percent of the required 28- day strength.
b. The 28-day compressive strength shall be as indicated.
c. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Typical Compressive Strength (28 Days): Provide the following minimum compressive strength (28 days) for concrete paving unless otherwise indicated: 3000 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50-0.60.
3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.
a. Slump Limit (High-Range Water-reducing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch, unless indicated otherwise.

C. Air Content, Exterior Exposed Concrete: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having the following air entrainment for all exposed concrete with a weathering probability of severe or moderate per ACI-318-19, ACI 305R, and ACI 306R.
1. Provide air entrainment of 6.0 percent, plus or minus 1.5 percent at point of delivery for 1-inch and 3/4-inch nominal maximum aggregate size, if required unless indicated otherwise.

D. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.

E. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] [1.00] percent by weight of cement.

F. Chemical Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M [or ASTM C 1116/C 1116M when fiber reinforcement is used]. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg. F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F (32 deg. C), reduce mixing and delivery time to 60 minutes.

B. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Grading."

C. Proceed with concrete paving installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

C. Slope stair and step treads at not less than 1.0 percent and not more than 2.0 percent cross slope to drain.

3.04 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.05 JOINTS

A. General: Form construction, isolation or expansion joint, and saw cut / contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
   1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Isolation (Expansion) Expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 20 feet maximum unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint and recess 1 inch from finish surface where no joint sealant is indicated.
   3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   5. Break steel at expansion joints.
   6. Dowels- provide prefabricated ‘speed dowel’ assemblies.

C. Saw Cut (Control) Joints: Form weakened-plane saw cut joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth plus 1/4 inch of the concrete thickness, as follows, and to match jointing of existing adjacent concrete paving:
   1. Continue steel reinforcement across sawcut joints unless otherwise indicated.

D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch radius unless otherwise noted. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in. Notify other trades as necessary to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, and side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg. F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F (10 deg C) and not more than 80 deg. F (27 deg C) at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 305R (ACI 305R M) and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg. F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

N. Provide sand and base materials as indicated.

3.07 **FLOAT/BROOM FINISHING**

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
   2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture. Required to meet slip coefficient requirement.
   3. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with **CBCSections 11B-302** and **11B-403**.

3.08 DETECTABLE WARNINGS

A. Detectable Warnings, General: Install detectable warnings as part of the concrete paving placement sequence. Set true to line and elevation. Comply with maximum slope and cross-slope requirements for accessible walkways.

1. Blockouts: Form blockouts in concrete and asphalt pavements for installation of detectable paving units.
   a. Tolerance for Opening Size: Plus 1/4 inch, no minus.

B. Detectable warnings surfaces shall comply with **CBC Section 11B-705.1.**

C. Detectable warning surfaces shall be yellow conforming to **FS 33538 of Federal Standard 595C,** except for locations at curb ramps, islands, or cut through medians where color used shall contrast visually with that of adjacent walking surfaces, either light-on-dark or dark-on-light. **CBC Sections 11B-705.1.1.3 and 11B-705.1.1.5.**

D. Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact. **CBC Section 11B-705.1.1.4.**

E. Provide 5 year minimum warranty per **DSA Bulletin 10/31/02, revised 04/09/08.**

F. Precast Concrete Detectable Warning Tiles: Comply with approved plans and details along with manufacturer's written instructions.

3.09 CONCRETE PROTECTION, CURING AND SEALING:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306R for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

F. Seal Concrete: Apply specified sealer in accordance with manufacturer’s recommendations.
   1. Apply full strength in two coats with airless sprayer at the manufacturer’s recommended rate.
   2. After the first coat is completely dry, apply second coat at right angles to the first coat.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117, the Americans with Disabilities Act, the CBC and as follows:
   1. Elevation: 1/8 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.

3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/8 inch. Surface must properly drain.
4. Surface Discontinuities: Maximum 1/4 inch, subject to further limitations of accessible routes.
5. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
6. Lateral Alignment and Spacing of Dowels: 1/4 inch.
7. Vertical Alignment of Dowels: 1/8 inch.
8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/8 inch per 12 inches of dowel.
9. Joint Spacing: 3 inches, except joint position shall be within 1/4 inch of objects in alignment with joint such as benches, light poles, pull boxes, etc.
10. Sawcut Joint Depth: Plus 1/4 inch, no minus.
11. Joint Width: Plus 1/16 inch, no minus.

B. Ramps: Ramps shall shed water away from the path of travel. Maximum ramp slope in direction of travel: 8.33 percent. Maximum ramp cross-slope perpendicular to direction of travel: 1.8 percent, plus 0.2 percent, minus 1.0 percent or as required to shed water.

3.11 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils. Provide markings with a minimum width of 3 inches.
1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb./gal.

E. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to mulitple accessible entrances. **CBC Section 11B-208.3.1.**

F. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. **CBC Section 11B-208.3.1.**

G. Minimum number of required accessible parkng spaces shall be provided in accordance with **CBC Table 11B-208.2** for each parking facility provided.

H. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. **CBC Section 11B-208.3.1.**

I. Accessible parking spaces and access aisles shall comply with **CBC Section 11B-502** and shall be dimensioned to the cenerlines of the marked lines as follows:
1. Parking spaces and access aisles shall be mareked according to **CBC figures 11B-502.2, 11B-502.3, and 11B-502.3.3**. Their surfaces shall comply with **CBC Section 11B-302** and shall be at the same level with the slopes not steeper than 1:48 in any direction. **CBC Section 11B-502.4.**

2. Parking spaces shall be 9'x18' minimum and van parking spaces shall be 12'x18' minimum with an adjacent access aisle of 5'x18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9'x18' minimum where the access aisle is 8'x18' minimum.
3. Access aisles shall be marked by a blue painted borderline around their perimeter. The areas within the blue borderlines shall be mareked with hatched lines a maxiumum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum requied length. **CBC Section 11B-502.3.3**
4. Access aisles(parking spaces as well- similar application) shall not overlap the vehicular way. **CBC Section 11B-502.3.4**
5. A verticle clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. **CBC Section 11B-502.5**

J. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with **CBC Section 11B-209 and 11B-503** as follows:
1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. **CBC Section 11B-503.4.**
2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maxiumum of 36" on center in a color contrasting with that of the aisle surface. **CBC Section 11B-503.3.**
3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. **CBC Section 11B-503.5.**

3.12 WHEEL STOPS

A. Securely attach wheel stops to paving with not less than two #4 galvanized steel dowels or rebar, minimum 18 inches long, located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 20 cu. Yd., or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg. F and below and when it is 80 deg. F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Owner, Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.14 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, cracked, chipped, stained or defective or that does not comply with requirements in this Section as determined by Landscape Architect. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude all but pedestrian traffic from paving for at least 28 days after placement. When construction traffic is permitted, maintain paving as clean as possible by providing adequate surface protection and by removing surface stains and spillage of materials as they occur.
    1. Rubber tire marks are unacceptable in the completed construction.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Project Completion inspections.

E. Repair of damaged, defective or rejected concrete is not permitted. Remove all concrete from expansion joint to expansion joint or greater as required to provide a constant continuous finish.

3.15 FINAL CLEANING

A. Remove all excess concrete, form materials, over pours, waste, etc., and legally dispose off-site.

B. Provide a final acid and power wash for all concrete paving surfaces. Do not use any material that will affect the appearance of the concrete.

C. All over pours in planting areas should be removed prior to landscape operations.

D. Clean concrete paving to remove stains, markings, dust, and debris.

END OF SECTION

SECTION 321373
PAVEMENT JOINT SEALERS

PART 1 - GENERAL

1.01 SECTION INCLUDES: RELATED DOCUMENTS

A. Exterior joint sealant for non-traffic surfaces.

1.02 RELATED REQUIREMENTS

A. Division 32 Section Concrete Paving.

1.03 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-), and 1/4-inch (6.4-mm) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

D. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

B. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

C. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

D. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

E. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

F. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

B. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).

C. When joint substrates are wet or covered with frost.

D. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

E. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Landscape Architect from manufacturer's full range.

2.03 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Multicomponent Pourable Urethane Sealant (Sealant #1):
   1. Available Products:
      a. Pecora Corporation; Urexpan NR-200.
      b. Sika Corporation, Inc.; Sikaflex - 2c SL.
   2. Type and Grade: M (multicomponent) and P (pourable).
   3. Class: 25.
   4. Use Related to Exposure: T (traffic).
   5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

D. Multicomponent Nonsag Urethane (Sealant #2):
   1. Available Products:
      a. Pecora Corporation; Dynatred.
      b. Sika Corporation, Inc.; Sikaflex - 2c NS
   2. Type and Grade: M (multicomponent) and NS (nonsag).
   3. Class: 25.
   4. Use Related to Exposure: T (traffic).

5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

2.04 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.05 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of backer materials.
   2. Do not stretch, twist, puncture, or tear backer materials.
   3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

F. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.04 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

3.06 SCHEDULE

A. Horizontal Joints, less than 5 percent slope; Sealant No. 1.

B. Horizontal Joints, grades steeper than 5 percent; Sealant No. 2

C. Vertical Joints; Sealant No. 2

END OF SECTION

SECTION 321723
PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Parking lot markings, including parking bays, arrows, curb markings, and ISA symbols.

1.02 RELATED REQUIREMENTS

A. Section 321216 - Asphalt Paving.

B. Section 321313 - Concrete Paving.

1.03 REFERENCE STANDARDS

A. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints; 2015 (Reapproved 2020).

B. California MUTCD - Manual of Uniform Traffic Control Devices for Streets and Highways; State of California Department of Transportation (FHWA's MUTCD as amended for use in California); current edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

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

C. Certificates: Submit for each batch stating compliance with specified requirements.
   1. Painted pavement markings.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.

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

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

1.08 SEQUENCING

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Painted Pavement Markings:
   1. Dunn-Edwards Corporation; Vin-L-Stripe Specialty Interior/Exterior Flat Zone Marking Paint.
   2. Sherwin Williams: Setfast Acrylic Traffic Paint.
   3. Pervo Paint Company: Acrylic Traffic Paint.
   4. Vista Paint Corporation: Traffic Paint.
   5. Equal.

2.02 PAINTED PAVEMENT MARKINGS

A. Painted Pavement Markings: As indicated on contract drawings.
   1. Marking Paint: In accordance with AASHTO MP 24.
      a. Parking Lots: White and Yellow as indicate on the design drawings.
      b. Symbols and Text: White.
      c. Wheelchair Symbols: Provide white and blue, color 15090 per Federal Standard 595C.

PART 3 EXECUTION

3.01 EXAMINATION

A. Identify existing markings for removal.

B. Verification of Conditions: Verify that pavement is dry and ready for installation.

C. Notify Architect of unsatisfactory conditions before proceeding.

3.02 PREPARATION

A. Establish survey control points for locating and dimensioning of markings.

B. Place barricades, warning signs, and flags as necessary to alert approaching traffic.

C. Clean surfaces prior to installation.
   1. Remove dust, dirt, and other debris.
   2. Remove rubber deposits, existing paint markings, and other coatings.

D. Temporary Markings: Apply as directed by Architect.

E. Apply paint stencils by type and color at necessary intervals.

3.03 REQUIREMENTS

A. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to multiple accessible entrances. CBC Section 11B-208.3.1.

B. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. CBC Section 11B-208.3.1.

C. Minimum number of required accessible parking spaces shall be provided in accordance with CBC Table 11B-208.2 for each parking facility provided.

D. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. CBC Section 11B-208.2.4.

E. Accessible parking spaces and access aisles shall comply with CBC Section 11B-502 and shall be dimensioned to the centerline of the marked lines as follows:
   1. Parking spaces and access aisles shall be marked according to CBC Section 11B-502.2, 11B-502.3, and 11B-502.3.3. Their surfaces shall comply with CBC Section 11B-302 and shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-502.4.
   2. Parking spaces shall be 9' x 18' minimum and van parking spaces shall be 12' x 18' minimum with an adjacent access aisle of 5' x 18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9' x 18' minimum where the access aisle is 8' x18' minimum.
   3. Access aisles shall be marked by a blue painted borderline around their perimeter. The area within the blue borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. CBC Section 11B-502.3.3.
   4. Access aisles (parking spaces as well - similar application) shall not overlap the vehicular way. CBC Section 11B-502.3.4.
   5. A vertical clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. CBC Section 11B-502.5.

F. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with CBC Section 11B-209 and 11B-503 as follows:
   1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-503.4.
   2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface. CBC Section 11B-503.3.
   3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. CBC Section 11B-503.5.

G. Electric Vehicle Charging Stations:
   1. Where electric charging stations are provided, they shall be provided in accordance with CBC Section 11B-228.3, Table 11B-228.3.2.1 and CBC Section 11B-812.
   2. Accessibility requirements for Public Use or Common Use EVCS facilities:

a. Vehicle spaces and access aisles serving them shall comply with CBC Section 11B-302. Access aisles shall be at the same level as the vehicle space they serve. Changes in level, slopes exceeding 1:48, and detectable warnings shall not be permitted in vehicle spaces and access aisles. CBC Section 11B-812.3.
b. Vehicle spaces, access aisles serving them and vehicular routes serving them shall provide a vertical clearance of 8’-2” minimum. CBC 11B-812.4.
c. Accessible routes between EVCS parking, equipment and the building or facility served shall be provided per CBC Section 11B-812.5.
d. Vehicle spaces for van accessible, standard accessible, ambulatory, and drive-up EVCS shall meet minimum length and width requirements per CBC Section 11B-812.6.
e. Accessible EVCS stalls shall be marked “EV Charging Only” per CBC Section 11B-812.9 and Figure 11B-812.9.
f. Access aisles for van accessible and standard accessible EVCS shall meet minimum length and width requirements and be marked per CBC Section 11B-812.7 the color of the perimeter, hatch lines and “No Parking” letters shall contrast with the surface color (blue color required for use at non-EVCS accessible parking shall not be used). Effective July 1, 2021, where one parking space and one electric vehicle charging space share an access aisle, access aisle marking shall comply with Section 11B-502.3.3 and shall not be required to comply with Section 11B-812.7.2. Additionally, where four or fewer total EVCS are provided within a facility, the access aisle for non-angled van accessible spaces may be located on either the driver or passenger side of the vehicle space. See CBC 11B-812.7.1 exception and 11B-812.7.2 exception.
g. Where four or fewer total EVCS are provided, identification with an International Symbol or Accessibility (ISA) shall not be required.
h. Where five to twenty-five total EVCS are provided, one van-accessible EVCS shall be identified with an ISA complying with section CBC Section 11B-703.7.2.1. The required standard accessible EVCS shall not be required to be marked with and ISA.
i. Where twenty-six or more EVCS are provided, all required van-accessible, and all required standard accessible EVCS shall be identified with an ISA.
j. The required ISA identification sign shall be reflective with a minimum 70 square inches; shall be visible from the EVCS it serves. The sign shall be permanently posted either immediately adjacent to the vehicle space or within the projected vehicle space at the head end of the vehicle space. Signs identifying van accessible vehicle spaces shall contain the designation “Van Accessible”. Signs shall be minimum 60” above the finish surface except that if the sign projects into a pedestrian circulation area, they shall be minimum 80” above finish surface per CBC Section 11B-812.8.
k. Ambulatory EVCS complying with CBC Section 11B-812.6.3 shall be required where 26 or move EVCS are provided per CBC table 11B-228.3.2.

3.04 INSTALLATION

A. General:
   1. Position pavement markings as indicated on contract drawings.
   2. Field location adjustments require approval of Architect.

B. Painted Pavement Markings:
   1. Apply in accordance with manufacturer's instructions.
   2. Apply in accordance with California MUTCD manual for details not shown.
   3. Marking Paint: Apply uniformly, with sharp edges.
      a. Applications: One coat.
      b. Wet Film Thickness: 0.015 inch, minimum.
      c. Stencils: Lay flat against pavement, align with striping, remove after application.

d. Length Tolerance: Plus or minus 3 inches.
e. Width Tolerance: Plus or minus 1/8 inch.

C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.

D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.

E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.

3.05 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Perform field inspection for deviations from true alignment or material irregularities.

C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.

D. Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals for additional requirements.

B. Temporary Markings: Remove without damaging surfaces.

3.07 PROTECTION

A. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.

B. Prevent approaching traffic from crossing newly applied pavement markings.

C. Replace damaged or removed markings at no additional cost to Owner.

D. Preserve survey control points until pavement marking acceptance.

END OF SECTION

SECTION 321740
STREETBOND SB150 (FLAT SURFACE)

PART 1 - GENERAL

1.01 DESCRIPTION

A. StreetBond® Advanced Coatings for Asphalt are specifically formulated for application to asphalt pavement and have been confirmed by a certified testing facility to possess a balance of performance properties for a durable and color-fast finish.

B. A variety of StreetBond® coating colors are available. Please refer to gaf.com to view these. Custom colors are available upon request.

C. Certain colors of the StreetBond® coatings have been independently verified to have an SRI greater than 29 and therefore can help projects qualify for points in the LEED® program under Heat Island Effect: Non-Roof. Please refer to gaf.com for further information.

D. Qualifications. Only Accredited StreetBond® Applicators may bid for and perform the imprinted portion of this work. Please refer to Section 1.03 DEFINITIONS.

E. StreetBond® products are manufactured in ISO 9001:2008 / ISO 14001:2004 facilities to ensure quality products produced in legally-responsible and environmentally-

F. conscious manner

G. StreetBond® coatings are only available from GAF.

1.02 REFERENCES

A. A. ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester.

B. B. ASTM D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

C. C. ASTM D2697 Standard Test Method for Volume of Nonvolatile Matter in Clear or Pigmented Coatings.

D. D. ASTM D522-93A Standard Test Method for Mandrel Bend Test of Attached Organic Coatings.

E. E. ASTM D1653 Standard Test Method for water vapor transmission through organic film coatings.

F. F. ASTM G154 QUV Accelerated Weathering Environment. Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.

G. G. ASTM D2369 Weight Solids Standard test method for Volatile Content of Coatings.

H. H. ASTM D1475 Standard Test Method for Density of Paint, Varnish, Lacquer, Other related products

I. I. ASTM D2240 (2000) Standard Test Method for Rubber property - Durometer hardness.

J. J. ASTM D5895 Standard Test Method of drying or curing during film formation of organic coatings using mechanical recorders.

K. K. ASTM D570 Standard Test Method for water absorption of plastics.

1.03 DEFINITIONS

A. “Accredited StreetBond® Applicator” has valid Certification for both Textured (stamped) and Non - Textured (flatwork) as offered by GAF and are reviewed on an annual basis. All Accredited StreetBond® Applicators have been qualified by GAF to perform the Work and offer a product Warranty.

B. “Approved Applicator” has valid Certification for non - textured (flatwork) application ONLY as offered GAF and are reviewed on an annual basis. Product Warranties may be available to Approved Applicators but require approval and supervision by a GAF Technical Sales Representative.

C. “Applicator” means the installer of the StreetBond® coatings.

D. “Owner” means the Owner and refers to the representative person who has decision making authority for the Work.

E. “TSR” is a GAF Technical Sales Representative who manages the StreetBond® product in a given territory.

F. “Stamped asphalt pavement” is asphalt pavement that has been subjected to imprinting or texturing in a specific pattern.

G. “Non - Stamped asphalt pavement” is asphalt pavement that is unstamped and is sometimes referred to as “flatwork”.

H. The “Work” is the asphalt pavement texturing work contemplated in this bid submission and specification.

I. “Scuffing” is a “tear” of the asphalt pavement caused by an external force - for example turning the steering wheel of a stationary vehicle. Scuffing is generally the result of poorly designed or improperly installed asphalt and would most - commonly be seen on weaker residential asphalt.

J. “Layer” is a signal thin pass of coating, applied with a texture spray gun, which is allowed to dry before the next layer is applied.

K. “Warranty” is a guarantee to the property owner that StreetBond® SB150, when properly applied will not peel, delaminate or show abnormal wear over specific period of time depending on the traffic volumes and number of layers applied. Please contact your local TSR for more details.

1.04 1.4 SUBMITTALS

A. A copy of the Accreditation Certificate, available from the Applicator, is required with submittal. Independent product test results available upon request.

PART 2 - PRODUCTS

2.01 **MATERIALS - STREETBOND® COATINGS**

A. StreetBond® coatings have been scientifically formulated to provide the optimal balance of performance properties for a durable, long - lasting color and textured finish to asphalt pavement surfaces. Some of these key properties include wear and crack resistance, color retention, adhesion, minimal water absorption and increased friction properties. StreetBond® coatings are environmentally safe and meet EPA requirements for Volatile Organic Compounds (VOC).

B. StreetBond® SB150 is a two part premium epoxy - modified, acrylic, waterborne coating specifically designed for application on asphalt pavements. It has a balance of properties to ensure good adhesion and movement on flexible pavement, while providing good durability. StreetBond® SB150 is durable in both dry and wet environments.

C. StreetBond® Colorant is a highly concentrated, high quality, UV stable pigment blend designed to add color to StreetBond® SB150 coatings. One unit of Colorant shall be used with one pail of StreetBond® coating material.
   1. Custom Colors
      a. Match RAL colors noted on plans/details.

2.02 PROPERTIES OF STREETBOND® COATINGS

A. The following tables outline the test results for physical and performance properties of the StreetBond® coatings as determined by an independent testing laboratory.

B. TABLE 1: Typical Physical Properties of StreetBond® Coatings

Characteristic	Test Specification	SB150
Solids by Volume	ASTM D2697	59.17%
Solids by Weight	ASTM D2369	71.60%
Density	ASTM D1475	13.27 lbs./gal. (1.59 kg/l)

C. TABLE 2: Typical Performance Properties of StreetBond® Coatings
   1. Characteristic
   2. Dry time (To re-coat)
      a. Test Specification - ASTM D5895 23 C; 37% RH
      b. SB150 - 35 min.
   3. Taber Wear Abrasion Dry H-10 wheel
      a. Test Specification - ASTM D4060 1 day cure
      b. SB150 - 0.33g/1000 cycles
   4. Taber Wear Abrasion Wet H-10 wheel
      a. Test Specification - ASTM D4060 7 days cure
      b. SB150 - 0.15g/1000 cycles
   5. QUV Accelerate Weathering Environment
      a. Test Specification - ASTM G - 151 deltaE 1,500hrs.
      b. SB150 - 0.53 (Brick)
   6. Hydrophobicity Water Absorption
      a. Test Specification - ASTM D570
      b. SB150 - 7.89%
   7. Shore A Hardness
      a. Test Specification - ASTM D2240
      b. SB150 - 80.8
   8. Mandrel Bend
      a. Test Specification - ASTM D522 - 93A
      b. SB150 - 1/8” @ 23 C
   9. Permeanc
      a. Test Specification - ASTM D1653
      b. SB150 - 5.6 perm
   10. VOC
      a. Test Specification - per MSDS
      b. 19 g/l
   11. Adhesion
      a. Test Specification - ASTMD4541
      b. SB150 - >300psi (692psi)
   12. Friction Wet
      a. Test Specification - ASTM E303 British Pendulum Tester
      b. SB150 - Wet=77.3 Dry=81.3

D. Certificates of Analysis are available upon request for each of these properties.

2.03 **EQUIPMENT FOR STREETBOND® APPLICATION**

A. The equipment described has been designed specifically for optimal application of StreetBond® coatings. Other equipment may or may not be suitable and could compromise the performance of the StreetBond® coatings and/or reduce crew productivity.
   1. The SB Flex Sprayer is a proprietary coating sprayer supplied by Intech Equipment and is capable of applying the StreetBond® coatings to the asphalt pavement surface in a thin, controlled film which will optimize the drying and curing time of the coating. A Graco RTX and RapidSprayerII sprayer may also be used.
   2. The StreetBond® Coatings Mixer is a motorized mixing device designed to ensure efficient and thorough blending of the StreetBond® components.
   3. Backpack or Hand - Held sprayer to apply the diluted StreetBond® Adhesion Promoter Concentrate.
   4. The RapidFinisher II is an electric powered broom produced by HUB Surfaces Systems which can be used in the application of StreetBond® coatings to improve productivity. It is especially useful on larger projects.

PART 3 - EXECUTION

3.01 **GENERAL**

A. StreetBond® coating shall be supplied and applied on non - textured paving surface by an Accredited StreetBond® Applicator in accordance with the plans and specifications or as directed by the Owner. Do not begin installation without confirmation of an Accreditation Certificate. Specifications for the execution of the StreetPrint® system can be found at gaf.com .

3.02 **PRE-CONDITIONS**

A. The condition of the paving substrate will impact the performance of the StreetBond® coatings. A highly stable asphalt pavement free of defects is recommended.

B. Prerequisites for New Pavement
   1. A durable and stable asphalt pavement mix design installed according to best practices over a properly prepared and stable substrate is a pre - requisite for all long - lasting asphalt pavement surfaces. The application of StreetBond® does not change this requirement.

C. Pavement Marking Removal: recommended guidelines
   1. Pavement markings may be removed by sandblasting, water - blasting, grinding, or other approved mechanical methods. The removal methods should, to the fullest extent possible, cause no significant damage to the pavement surface.
   2. The Owner shall determine if the removal of the markings is satisfactory for the application of StreetBond® coatings. Work shall not proceed until this approval is granted.

D. Surface Preparation
   1. The asphalt pavement surface shall be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials, and chemical residue.

3.03 **APPLICATION OF STREETBOND® COATINGS**

A. Coating Application Guidelines

1. The Applicator shall use the SB Flex Spray System or suitable texture coatings sprayers to apply the StreetBond® coatings.
2. The pavement surface shall be completely dry and thoroughly cleaned prior to application of the coatings.
3. The coating application shall proceed as soon as practical upon completion of the imprinting of the asphalt pavement where applicable.
4. For polished asphalt, StreetBond® Adhesion Promoter should be applied directly to the asphalt and allowed to dry completely prior to the first layers of coating.
5. For concrete surfaces, StreetBond® WB Concrete Primer or StreetBond® QS Concrete Primer should be applied and allowed to cure prior to the first layers of coating. Please consult Technical Data sheets for more details on applications.
   a. Both new and existing concrete should be acid etched prior to the primer application.

B. The first layer of coating shall be spray applied then broomed to work the coating material into the pavement surface. Subsequent applications shall be sprayed then broomed or rolled. Each application of coating material shall be allowed to dry to the touch before applying the next layer.
   1. Airless sprayers cannot be used due to high aggregate content of StreetBond.

C. The Applicator shall apply the StreetBond® coatings only when the air temperature is 50°F / (10°C) and rising and will not drop below 50°F / (10°C) within 24 hours. No precipitation should be expected within 24 hours.

D. Follow manufacturers Application and Specifications Manual for process and procedures on the application of StreetBond. (www.gaf.com)

E. Use equipment that is designed specifically for the application of StreetBond.
   1. Refer to GAF information in the StreetBond Application and Specifications Manual. (www.gaf.com)

3.04 **COATING COVERAGE & THICKNESS**

A. Coating coverage and thickness is as outlined in TABLE 4 below. Actual coverage may be affected by the texture of the asphalt pavement substrate and the imprint pattern selected. There will be less coverage with the first layer and higher coverage with subsequent layers.

B. TABLE 4: Coating Coverage & Thickness

Use	Min # of Layers	App. Rate/Layer	Total App./rate for system	Dry Film Thickness (DFT) mils
No vehicular traffic(pedestrian)	3	1 unit/600 sf	3 units/600 sf	18
Low vehicular traffic(<5 cars/day residential drives/medians/plazas	3	1 unit/600 sf	3 units/600 sf	19
Medium vehicular traffic (<2000 cars/day)	4	1 unit/600 sf	4 units/600 sf	26
Heavy vehicular traffic (2000-3000 cars/day)	4	1 unit/600 sf	4 units/600 sf	26
Vehicular Traffic - Turn Lanes (<3000 cars/day)	6	1unit/600 sf	6units/600 sf	38

C. Additional layers of StreetBond® SB150 coatings may be used to provide additional build thickness in high wear areas such as vehicle wheel paths and turning areas.

D. *1 unit is a nominal 5 gallon pail comprising Part A, Part B and Colorant (approximately 4.12 gallons). 1 unit when sprayed as a single layer covers approximately 600sqft (55.7 sqm), with an approximate thickness of 6.3mil (0.16mm) dry.

E. No warranty is provided for traffic levels above 3000 cars per day per lane.

3.05 **OPENING TO TRAFFIC**

A. Minimally, StreetBond® SB150 coating must be 100% dry and sufficient curing time must be allowed before traffic is permitted on the surface.

B. If StreetBond® coatings are applied when moisture cannot evaporate, then the coating will not dry. The drying and curing of StreetBond® coatings have a direct impact on performance.

3.06 **MEASUREMENT**

A. The measured area is the actual area of asphalt pavement where StreetBond® has been applied, measured in place. No deduction will be made for the area(s) occupied by manholes, inlets, drainage structures, bollards or by any public utility appurtenances within the area.

END OF SECTION

SECTION 323125
AMERISTAR - MONTAGE II®

PART 1 - GENERAL

1.01 **WORK INCLUDED**

A. The contractor shall provide all labor, accessible gate hardware, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein.

1.02 **RELATED WORK**

A. Section 312200 - Grading
B. Section 312316 - Excavation
C. Section 312323 - Fill
D. Section 033000 - Cast-in-Place Concrete

1.03 **SYSTEM DESCRIPTION**

A. The manufacturer shall supply a total fence system of Montage II® Welded and Rackable (ATF - All Terrain Flexibility) Ornamental Steel Invincible, Classic, Majestic or Genesis™ design. The system shall include all components (i.e., panels, posts, gates and hardware) required.

1.04 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
C. ASTM D523 - Test Method for Specular Gloss.
D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
J. ASTM F2408 - Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.06 **SUBMITTAL**

A. The manufacturer’s literature shall be submitted prior to installation.

B. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, hardware and accessories specified in the section.
   1. Gates and hardware, including accessible gate lever lockset.

C. Shop Drawings:
   1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
   2. Architect to approved prior to ordering fence and gate materials.

1.07 **PRODUCT HANDLING AND STORAGE**

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.08 **PRODUCT WARRANTY**

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - MATERIALS

2.01 **MANUFACTURER**

A. The fence system shall conform to Montage II® Welded and Rackable (ATF - All Terrain Flexibility) Ornamental Steel, Genesis™ design, extended picket bottom rail treatment, 2-Rail; 3-Rail; or 4-Rail, design, style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

B. Gate hardware:
   1. As noted on details.

2.02 **MATERIAL**

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.

B. Material for pickets shall be 1” square x 14 Ga. tubing. The rails shall be steel channel, 1.75” x 1. 75” x .105”. Picket holes in the rail shall be spaced 4.715” o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.03 **FABRICATION**

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar' s proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Swing gates shall be fabricated using 1.75” x 14ga Forerunner double channel rail, 2” sq. x 11ga. gate ends, and 1” sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75” sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6' .

Table 1 – Minimum Sizes for Montage II Posts

Fence Posts	Panel Height
2-1/2” x 12 Ga.	Up to & Including 6’ Height
3” x 12 Ga.	Over 6’ Up to & Including 10’ Height
4” x 11 Ga.	Over 10’ Height

Gate Leaf	Gate Height			
	Up to & Including 4'	Over 4’ Up to & Including 6’	Over 6’ Up to & Including 8’	Over 12’
Up to 4’	2-1/2" x 12Ga	3" x 12Ga	3" x 12Ga	-
4’1” to 6’	3" x 12Ga	4" x 11Ga	4" x 11Ga	-
6’1” to 8’	3" x 12Ga	4” x11Ga	6” x 3/16”	-
8’1” to 10’	4" x 11Ga	6” x 3/16”	6” x 3/16”	-
10’1” to 12’	4" x 11Ga	6” x 3/16”	6” x 3/16”	-
12’1” to 14’	4" x 11Ga	6” x 3/16”	6” x 3/16”	-
14'1" to 16'	6” x 3/16”	6” x 3/16”	6” x 3/16”	

Table 2 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).

Weathering Resistance			D822 D2244, D523 (60° Method)		Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).						
Table 3 – Montage II – Post Spacing By Bracket Type											
Span	For INVINCIBLE 8' Nominal (91.50" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92.625" Rail)						
Post Size	2-1/2"	3"			2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	
Bracket Type	Industrial Flat Mount (BB301)		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrical Universal 2.5" (BB302) 3" (BB303)		Industrical Flat Mount (BB301)		Industrial Swivel (BB304)		
Post Settings ± ½" O.C.	94.5"	95"	94.5"	95"	96"	96.5"	96"	96.5"	96"	*96-1/2"	

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel.

2.04 **HARDWARE**

A. Pedestrian Gate Hardware: Per drawing

B. Kickplate: Smooth solid metal surface (12GA), to match frame material and finish, along the entire width of the gate, and minimum of 10" above the pedestrian surface to be provide at all accessible pedestrian gates.

C. All gate drop rod assemblies are to use a 1/2" diameter solid steel center stop. Provide a 12" steel sleeve. In asphalt areas secure sleeve in a 12" diameter by 18" deep concrete footing.

D. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2-inch- (12.7 -mm-) diameter, round steel bars, hot-dip galvanized after fabrication, unless otherwise shown on drawings. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.

E. Gate Keeper: Galvanized steel, duckbill type to auto-engage in open position and hold open. High Performance coating to match fence and gate color.

F. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with **CBC Section 11B-404.**

G. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons. **California Referenced Standards code. T-24 part 12, Section 12-10-202, Item (F).**

H. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of th door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. **CBC Section 11B-404.2.10**

I. The clear opening width for a door shall be 32" minimum. For a swinging doors it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34" and 4" maximum projections into it between 34" and 80" above the finish floor or ground. Door closers and stops shall be permitted to be 78" minimum above the finish floor or ground. **CBC Section 11B-404.2.3**

J. Handles pulls, latches, locks, and other operable parts on accesisible doors shall comply with **CBC Section 11B-309.4** and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34" minimum and 44" maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usalbe from both sides. **CBC Section 11B-404.2.7**

K. The force for pushing or pulling open a door shall be as follows: **CBC Section 11B-404.2.9**
   1. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds(22.2 N)maximum to comply with CBC Section 11B-309.4

L. Door closing speed shall be as follows: **CBC Section 11B-404.2.8**
   1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is **5** seconds min.
   2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is **1.5** seconds minimum.

M. Thresholds shall comply with **CBC Section 11B-404.2.5**

N. Floor stops shall not be located in the path of travel and 4" maximum from walls. **DSA Policy 99-08**.

O. Hardware (including panic hardware) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met per **DSA Interpretation 10-08 DSA/AC (External), revised 4/28/09.** Such conditions must be clearly demonstrated and indicated in the specifications:
   1. Such hardware has a 'dogging' feature.
   2. It is dogged during the time the facility is open.
   3. Such 'dogging' operation is performed only by employees as their job function(non-public use).

P. Pair of doors: limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. **CBC Section 11B-703.4.2.1**

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 **PREPARATION**

A. All new installation shall be laid out by the contractor in accordance with the approved plans, details and shop drawings.

B. Clean surfaces thoroughly prior to installation.

3.03 **FABRICATION**

A. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons. **California Referenced Standards code. T-24 part 12, Section 12-10-202, Item (F).**

B. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of th door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. **CBC Section 11B-404.2.10**

3.04 **FENCE INSTALLATION**

A. Fence post shall be spaced according to approved plans, details and shop drawings, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.05 **FENCE INSTALLATION MAINTENANCE**

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.06 **GATE INSTALLATION**

A. Gate posts shall be spaced according to the approved plans, details and shop drawings. Gate hardware shall be provided by the Contractor and shall be installed per manufacturer' s recommendations.

B. Post footings shall follow approved plans, details and shop drawings.

C. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.07 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From Indicated Position: 1 inch.

C. Minimum Distance from Property Line: 6 inches. Unless otherwise noted.

3.08 **CLEANING**

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

C. Clean fence with mild household detergent and clean water rinse well.

3.09 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 323113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Posts, rails, and frames.
B. Wire fabric.
C. Concrete.
D. Manual gates with related hardware.
E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete anchorage for posts.
B. Section 087100 - Door Hardware: Gate locking device.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
G. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.
H. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric; 2025.
I. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).
J. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).
K. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence; 2008 (Reapproved 2022).
L. CLFMI CLF-FIG0111 - Field Inspection Guide; 2014.
M. CLFMI CLF-PM0610 - Product Manual; 2017.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Fence Installer Qualification Statement.

C. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

D. Shop Drawings: Fence, gates, and hardware indicate in plan layout and elevation, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

E. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.

F. Field Inspection Records: Provide installation inspection records that include post settings, framework, fabric, barbed wire, fittings and accessories, gates, and workmanship.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Spcial Warranty: Installer agrees to repair or replace components of chain link fences and gates that fail in materials or workmanship with specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to comply with performance requirements.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      c. Faulty operation of gate operators and controls.

C. Correct defective Work within a five year period after Date of Substantial Completion.

D. Provide 15 year manufacturer warranty for chain link fabric.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Chain Link Fences and Gates:
   1. Master-Halco, Inc: www.masterhalco.com/#sle.
   2. Merchants Metals: www.merchantsmetals.com/#sle.
   3. Substitutions:

2.02 MATERIALS

A. Posts, Rails, and Frames: Per detail:

B. ASTM A1011/A1011M, Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; zinc coating conforming to ASTM F1043 and ASTM F1083.

C. Line Posts: Type I round.

D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.

E. Conform to CLFMI CLF-PM0610.

F. Wire Fabric: Per detail:

G. steel chain link fabric.

H. Conform to CLFMI CLF-PM0610.

I. Concrete: 3,000 min.:

J. Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 3,000 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.

2.03 COMPONENTS

A. Line Posts:
   1. Under 6 ft. high and under: 1-7/8 inch O.D.
   2. Over 6 to 8 ft. high: 2.375-inch O.D., SCHD 40.

B. Corner and Terminal Posts:
   1. 6 ft. high and under: 3" inch O.D., SCHD 40.
   2. Over 6 ft. high: 4 inch O.D., SCHD 40.

C. Gate Posts: diameter.

D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.

E. Bottom Rail: 1.66 inch diameter, plain end, sleeve coupled.

F. Gate Frame: 1.66 inch diameter for welded fabrication.

G. Fabric: 2 inch diamond mesh interwoven wire, 6 gage, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage knuckle end closed. Unless otherwise noted on plans.

H. Tension Wire: thick steel, single strand.

I. Brace Band: Galvanized and beveled.

J. Tension Bands and Straps: 9 GA min.; 3/4 inch width min.; 5/16" x 1-1/4" carriage bolt per band; color to match fabric. 12 inches o.c. min.

K. Tension Bars: [3/4-inch x 3/16-inch] ([____] mm) thick steel. Color to match fabric.

L. Tie Wire: Aluminum alloy steel wire. Line post tie at 12 inches o.c. min. Top and bottom tie at 18 inches o.c. min.

M. Polymer Coated Color Fittings: In compliance with ASTM F626. Polymer coating minimum thickness 0.006 in. (0.152 mm) fused and adhered to zinc coated fittings

2.04 MANUAL GATES AND RELATED HARDWARE

A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp.

B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp.

C. Hinges: Finished to match fence components.
   1. Brackets: Round.
   2. Mounting: Center.
   3. Closing: Self.
   4. Products:
      a. D&D Technologies USA, Inc; C13000: www.ddtechglobal.com/#sle.
      b. Locinox; Mammoth 180 Gate Closer: www.locinox.com. Provide adapters for round posts.

c. Substitutions: See Section 016000 - Product Requirements.

D. Latches: Finished to match fence components.
1. Brackets: Round.
2. Locking: Mechanical.

E. Ground fence in accordance with Section 337900.

2.05 **ACCESSORIES/HARDWARE**

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

C. Privacy Slats: Vinyl strips, 2" mesh. sized to fit fabric weave.

D. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with **CBC Section 11B-404.**

E. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons. **California Referenced Standards code. T-24 part 12, Section 12-10-202, Item (F).**

F. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of th door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. **CBC Section 11B-404.2.10**

G. The clear opening width for a door shall be 32" minimum. For a swinging doors it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34" and 4" maximum projections into it between 34" and 80" above the finish floor or ground. Door closers and stops shall be permitted to be 78" minimum above the finish floor or ground. **CBC Section 11B-404.2.3**

H. Handles pulls, latches, locks, and other operable parts on accesisible doors shall comply with **CBC Section 11B-309.4** and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34" minimum and 44" maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usalbe from both sides. **CBC Section 11B-404.2.7**

I. The force for pushing or pulling open a door shall be as follows: **CBC Section 11B-404.2.9**
1. Interior hinged doors, sliding or folding doors: **5 pounds(22.2N)** maxiumum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed **15 pounds (67N)**. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
2. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds(22.2 N)maximum to comply with CBC Section 11B-309.4

J. Door closing speed shall be as follows: **CBC Section 11B-404.2.8**
1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is **5** seconds min.
2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is **1.5** seconds minimum.

K. Thresholds shall comply with **CBC Section 11B-404.2.5**

L. Floor stops shall not be located in the path of travel and 4" maximum from walls. **DSA Policy 99-08**.

M. Hardware (including panic hardware) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met per **DSA Interpretation 10-08 DSA/AC (External), revised 4/28/09.** Such conditions must be clearly demonstrated and indicated in the specifications:
   1. Such hardware has a 'dogging' feature.
   2. It is dogged during the time the facility is open.
   3. Such 'dogging' operation is performed only by employees as their job function(non-public use).

N. Pair of doors: limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. **CBC Section 11B-703.4.2.1**

2.06 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.

B. Hardware: Match fence color

C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that areas are clear of obstructions or debris.

3.02 PREPARATION

A. Removal: Obstructions or debris.

B. Ground Preparation:

3.03 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Place fabric on outside of posts and rails.

C. Set intermediate posts plumb , in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

D. Line Post Footing Depth Below Finish Grade: ASTM F 567.

E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F 567.

F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.

H. Install center brace rail on corner gate leaves.

I. Do not stretch fabric until concrete foundation has cured 28 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

K. Position bottom of fabric 2 inches above finished grade.

L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

N. Do not attach the hinged side of gate to building wall; provide gate posts.

O. Install hardware and gate with fabric to match fence.

P. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

Q. Install gate locking device specified in Section 087100.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Do not infringe on adjacent property lines.

3.05 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.

C. Gates: Inspect for level, plumb, and alignment.

D. Workmanship: Verify neat installation free of defects. See CLFMI CLF-FIG0111 for field inspection guidance.

3.06 CLEANING

A. Leave immediate work area neat at end of each work day.

B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

C. Clean fence with mild household detergent and clean water rinse well.

D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.

E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

F. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

3.07 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

END OF SECTION

SECTION 323300
SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Benches.

B. Tables.

C. Waste receptacles.

D. Bike racks.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Bollard infill and underground encasement.

B. Section 055000 - Metal Fabrications: Anchors to attach site furnishings to mounting surfaces.

C. Section 321313-Concrete Paving: Mounting surface for site furnishings

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

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

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.

E. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).

F. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

G. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

H. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.

C. Shop Drawings:

1. Indicate plans for each unit or groups of units, elevations with model number, overall dimensions; construction, and anchorage details.
2. For bike rack: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.

D. Samples: Submit two sets of manufacturer's available colors for metal furnishings.

E. Samples: Submit two sets of manufacturer's available colors and finishes for precast furnishings.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer’s warranty against defects in materials or workmanship for ductile iron castings for a period of 10 years from Date of Substantial Completion.

C. Provide manufacturer’s Lifetime Warranty against defects in materials or workmanship for wood benches manufactured from solid teak.

1.06 DELIVERY, STORAGE, AND HANDLING

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

B. Handle with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Furnishings:
1. Ribbon Rack;https://ribbonrack.com/
2. Substitutions: See Section 016000 - Product Requirements.

B. Precast Furnishings:
1. Quick Crete Products Corp; _____: www.quickcrete.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

2.02 METAL FURNISHINGS

A. Metal Furnishings, General:
1. Steel components: Plates, bars, and shapes complying with ASTM A36/A36M and tubing complying with ASTM A500/A500M; cleaned, treated, and powder-coated.
2. Hardware: Stainless steel.
3. Carbon steel, ASTM A53/A53M

B. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
1. Capacity: Seven bicycles.
2. Mounting: In-ground anchor.
3. Finish: Powder coat, maintenance-free and weather-resistant.
4. Color: As indicated on drawings.
5. Accessories: In-ground grout cover.
6. Products:
a. Ribbon Rack;https://ribbonrack.com/

2.03 PRECAST CONCRETE FURNISHINGS

A. Precast Concrete Furnishings, General:
1. Precast Concrete Components: Mixture of cement, aggregates, water, and mineral colors; molded to shape, and reinforced with steel bars.
a. Finish: As indicated on drawings.
b. Color: As indicated on drawings.

c. Clear Sealers: Anti-graffiti.
2. Hardware: Stainless steel.

B. Tables: Precast concrete table and pedestal
1. Table: Precast concrete frame with precast table top.
2. Pedestal: Precast concrete block
3. Mounting: Surface, using concealed anchor rods.
4. Products:
a. Quick Crete Products Corp; ____: www.quickcrete.com/#sle.

C. Waste Receptacles: Precast concrete waste receptacle with removable lid.
1. Capacity: 26 GAL.
2. Lids:
a. Material: Steel.
b. Type: Flat.
3. Mounting: Surface, using concealed anchor rods.
4. Products:
a. Quick Crete Products Corp; ____: www.quickcrete.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that mounting surfaces, preinstalled anchor bolts, or other mounting devices are properly installed; and ready to receive site furnishing items.

B. Do not begin installation until unacceptable conditions are corrected.

3.02 PREPARATION

A. Ensure surfaces to receive site furnishing are clean, flat, and level.

3.03 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.

B. Post-Installed Anchors: Comply with ICC-ES AC308.

END OF SECTION

SECTION 323314
SITE BICYCLE LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle lockers.

1.02 RELATED REQUIREMENTS

A. Section 321313 - Concrete Paving: Mounting surface for bicycle lockers.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

D. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Lockers:
   1. Dura Bike.

2.02 BICYCLE LOCKERS

A. Exterior Steel Bicycle Lockers: Secure storage enclosure fabricated of steel panels with factory applied finish and factory installed hardware.
   1. Style: DL2.
   2. Capacity: Two bicycles per unit.
   3. Interior Partition: Exterior grade OSB with factory applied sealer.
   4. Finish: Powder coat, factory applied over primer.
   5. Color: As indicated on drawings.

B. Materials:
   1. Bar, Round and Flat, Carbon Steel: ASTM A36/A36M.
   2. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle lockers.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Do not begin installation until unsatisfactory substrates have been properly repaired.

3.02 PREPARATION

A. Ensure surfaces to receive bicycle lockers are clean, flat, and level.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bicycle lockers level, plumb, square, and correctly located as indicated on drawings.

C. Post-Installed Anchors: Comply with ICC-ES AC308.

D. Surface Flange Installation: Anchor bicycle lockers securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.

E. Freestanding Installation: Place in location indicated on drawings.

3.04 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 323353
ARCHITECTURAL SITE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete site walls.

B. Concrete retaining walls.(48" or less in height)

C. Other architectural site concrete as indicated.

1.02 RELATED REQUIREMENTS

A. Division 00 Section - 003100 Available Project Information(Geotechnical Report)

B. Division 07 Section - Joint Sealants

C. Division 09 Section - Permanent Non-Sacrificial Anti-Graffiti

D. Division 32 Section - Concrete Paving

E. Division 32 Section - Concrete Paving Joint Sealants

1.03 DEFINITIONS

A. Cast-in-Place Architectural Site Concrete: Non-building formed concrete that is exposed to view in completed exterior work and that requires concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural site concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.04 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural site concrete to attend, including the following:
    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. District's Representative(s).
    d. Ready-mix concrete manufacturer.
    e. Architect's Representative(s)
    f. Cast-in-place architectural site concrete subcontractor.
    g. Inspector of Record (IOR).
    h. Subcontractor for any adjacent work

2. Review testing and inspection procedures, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural site concrete.
3. Contractor to provide meeting minutes for pre-installation conference.

1.05 SUBMITTALS

A. Product Data: For each type of product.
   1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, all accessory material, etc.: Indicate compatibility with other materials used.

B. Samples for Initial Selection: For each type of product, ingredient or admixture requiring color selection.
   1. Submit manufacturer selected range of colors and products for review.
   2. Provide custom colors or samples as required.
   3. Upon selection of color submit 12"X12" sample of material in the specified color/finish for review by the Landscape Architect in addition to the specified mock-ups.

C. LEED Submittals:
   1. Product Data for Credit MR 4.1 [and Credit MR 4.2]: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing at least 40% fly ash as a replacement for Portland cement or other Portland cement replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.

D. Design Mixtures: Submit proposed mix designs and test data for each class, color, application, and strength of concrete and for each method of placement.
   1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905A.3.
   2. Mix designs shall be prepared and signed by a structural or civil engineer registered in the State of California.
      a. Mix designs shall be reviewed by the Architect and Structural Engineer of Record (SEOR).
   3. Identify for each mix design submitted the method by which proportions have been selected.
      a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength calculations.
      b. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength face results. Provide gross weight and yield per cubic yard of trial mixes.
      c. Indicate quantity of each ingredient per cubic yard of concrete.
      d. Indicate type and quantity of admixtures proposed or required.
      e. Indicate water to cement ratio by weight.
      f. Measured slump.
      g. Measured air content.
      h. Provide shrinkage test results.
      i. Provide maximum [5%] fly ash; ground granulated blast-furnace slag, and/or silica fume content as Portland cement replacement in all concrete.
      j. No fly ash will be permitted
   4. Submit proposed alternate design mixtures for review by the Architect and SEOR(Strutural Engineer of Record) when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

5. Mix designs for each application must be from a single source for the duration of the project. Multiple venders or courses will not be permitted.
6. All mix designs must be wet stamped by a licensed Engineer.

E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
2. Comply with ACI 315, part B and CRSI requirements.

F. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural site concrete.
1. Engineering Responsibility: Formwork shop drawings shall be prepared by or under the supervision of a licensed professional engineer detailing fabrication, assembly, and support of formwork.
2. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
3. Location of form ties and patterns are subject to approval of the Landscape Architect. For walls less than 18” high, ties to be located above and below wall face, whenever possible.
4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.

G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete.
1. Location of construction joints are subject to approval of the Architect.
2. Construction joints locations should align with reveal locations as located per drawings.
3. Provide custom form boards as required for joint alignment noted per drawings.
4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.

H. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

I. Samples: For each of the following materials:
1. Form-facing panel.
2. Form ties.
3. Form liners.
4. Coarse- and fine-aggregate gradations.
5. Chamfers and rustications.
6. Reveals
7. One quart sample of sand and fine aggregate
8. On quart sample of coarse aggregate

J. Qualification Data: For manufacturer (batch plant).

K. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.

L. Material Certificates: For each of the following:
1. Cementations materials.
2. Aggregates and sand.
3. Admixtures.
4. Form materials and form-release agents.

5. Steel reinforcement and accessories.
    a. Provide mill test certificates for all reinforcing steel, showing physical and chemical analyses. For steel that will be welded, include in the chemical analysis the percentages of carbon, manganese, copper, nickel, chromium, phosphorus and sulfur, and optionally, the percentages of molybdenum and vanadium.
6. Curing compounds.
7. Surface treatments.
8. Bonding agents.
9. Adhesives.
10. Semi rigid joint filler.
11. Joint-filler strips.
12. Repair materials.

M. Material Test Reports: For the following, by a qualified testing agency:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

N. Field Quality-control Reports. Submit reports of all compressive strength, slump, shrinkage and air content tests required by the authorities having jurisdiction and as indicated.
1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.

O. Minutes of pre-installation conference.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with CBC Chapter 19A.
1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.

B. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.
1. ACI 301, "Specifications for Structural Concrete".
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
4. ACI 303.1 "Specifications for Cast-in-Place Architectural Concrete".
5. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
6. ACI 305R, "Hot Weather Concreting".
7. ACI 306.1, "Standard Specification for Cold Weather Concreting".
8. ACI 318, "Building Code Requirements for Structural Concrete".
9. ACI 347, "Guide to Formwork for Concrete".
10. ACI 318, "Building Code Requirements for Structural Concrete."
11. ACI SP-66, "ACI Detailing Manual".
12. CRSI, "Manual of Standard Practice".
13. CRSI, "Placing Reinforcing Bars".

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."
2. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

4. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations for Cast-in-Place Architectural Site Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide cast-in-place architectural site concrete of consistent quality in appearance and physical properties for the duration of the project.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete,"[Sections 1 through 5.] [Sections 1 through 5 and Section 6, "Architectural Concrete."]
2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance

H. Welding Qualifications: Comply with CBC Chapter 17A.
1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."

I. Mockups: Before casting architectural site concrete, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints, surface finish, texture, tolerances, reveals edges, bulkhead or cold joints, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups full-size, matching architectural site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated.
3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.
4. Demonstrate curing, cleaning, and protecting of cast-in-place architectural site concrete, finishes, and contraction and expansion joints, as applicable.
5. Required Mock-up Types:
   a. Walls: Construct at least 6 linear feet by 4 foot height of finished concrete site walls for each color, finish, and mix design. Thickness of walls as noted on plans.
   b. Benches and Seats: Construct at least 6 linear feet of finished concrete site benches and seats.
   c. Planters: Construct at least 6 linear feet of finished concrete site planters.
   d. Amphitheaters and Steps: Construct at least 6 linear feet of finished concrete steps/amphitheater seating with 3 risers minimum.
   e. As-Cast Retarder Finishes: Mockups shall clearly demonstrate a consistent depth-of-cut for retarder finishes for Architect's review.

f. Repairs: In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes, honeycombing, spalls, surface blemishes, etc. to match adjacent undamaged surfaces.

6. Mock-up Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete.
   a. The mock-up acceptence shall be judged between a distance of 5 feet to 10 feet, at the Architects discretion.
   b. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
   c. The Architect may require modifications to mockups to obtain acceptable results.
   d. The Architect may require modifications to mockup repairs to obtain acceptable results.
   e. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups may be required.
   f. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.
7. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mock-up on-site for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. If sufficient permanent architectural site work has been completed, Contractor may submit a written request to Architect to transfer quality control for architectural site concrete from the accepted mockups to one or more designated portions of the permanent work.

1.07 PROJECT CONDITIONS:

A. Traffic Control: Maintain access for Owner's operations and for vehicular and pedestrian control required for construction activities.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
   1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
   2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
   3. Avoid damaging applied coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Form-Facing Panels for all exposed As-Cast and Exposed-Aggregate Concrete Finishes: Provide steel, glass-fiber-reinforced plastic, or overlain exterior-grade plywood panels, no absorptive, that will provide continuous, true, and smooth architectural site concrete surfaces, with no wood grain, honeycombing or patch transfer.
   1. Faced plywood panels shall comply with, or be equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints.

a. Smooth As-Cast Finish: High-Density Overlay (HDO). Provide one of the following panels, or comparable substituted product:
   1) Olympic Panel Products, "Multipour Concrete Form." Overlay Color: Buff.
   2) Pacific Laminate Products, "ProFace HDO." Overlay Color: White.
   3) Sylvan Products, LLC, "Armor Ply HDO" Overlay Color: Buff.
b. Retarder As-Cast Finish: Medium-Density Overlay (MDO), with mill-applied release agent and edge sealant. Provide one of the following panels, or comparable substituted product:
   1) Olympic Panel Products, "B-Matte 333 MDO Concrete Form." Overlay Color: Brown.
   2) Pacific Laminate Products, "ProFace MDO." Overlay Color: Black.
   3) Sylvan Products, LLC, "Armor Ply MDO" Overlay Color: Brown.

2. Curved Work: Kerf back of plywood form-facing panels, or use accepted flexible or curved forms for curved work with a radius of 100 feet or less to match finish provided by form material noted in items 1 and 2 above.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide surfaces without gradual or abrupt irregularities that exceed specified formwork surface class.
1. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
2. Finished work is to be free of seams or form markings.

D. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

E. Form Joint Sealant: Urethane or silicone elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS that adheres to form joint substrates. Form joint sealant shall be compatible with form-facing panels.

F. Form Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood. Form sealer shall be compatible with form-facing panels. All seams and joints are to be sealed.

G. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural site concrete surfaces and will not impair subsequent treatments of those surfaces. Form-release agent shall be compatible with form-facing panels.
1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
2. Form-release agents shall be non-staining.
3. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Surface Retarder (In Form): Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
1. Provide Architectural Concrete Chemicals(ACC) "Altus VOC Series" or accepted comparable substitute.

I. Surface Retarder (Top Surface): Chemical liquid set retarder, for application on top surface of formed applications to match finish at formed faces, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
1. Provide W. R. Grace "Top-Cast" or accepted comparable substitute.

J. Form Ties: Factory-fabricated, stainless steel or fiberglass color keyed to wall color snap ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish ties with tapered plastic tie cone spreaders that, when removed, will leave holes 3/4 inch in diameter on concrete surface.
2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm) after exposing aggregate, from the architectural site concrete surface.
3. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) in diameter, of color selected by Architect from manufacturer's full range.
4. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

K. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.

L. Provide custom form boards as required to align seams with reveals indicted on plans.

2.02 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 60 percent.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed, unless otherwise indicated.

D. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
1. Where legs of wire bar supports contact forms, use CRSI Class 2, stainless-steel bar supports.

F. Tie Wire: Minimum 16 ga. annealed wire, black, galvanized or coated finish to match rebar.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type II, or Type IV, gray, unless white cement is required to achieve colors indicated. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
1. Comply with CBC section 1903A.3.
2. Maximum Coarse-Aggregate Size: [3/8] inch nominal. Maximum size shall also not be larger than 1/4 of the narrowest dimension between forms, 1/3 the depth of slab nor more than 3/4 of the minimum clear spacing between individual reinforcing bars.
   a. Gradation: Uniformly graded.
   b. Source: Reliance, San Gabriel, or Carrol Canyon

C. Normal-Weight Fine Aggregate: ASTM C 33 or ASTM C 144, manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement and free of materials which may cause staining and light in color
1. Source: Reliance, Fosters or Corona.
2. Color to be white to light with no dark material.

D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.04 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   3. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
   1. Products: Subject to compliance with requirements, provide one of the following(as required):
      a. Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
      b. Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
      c. Sika Corporation; Control 40.

2.05 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Clear, Waterborne (Non-Colored Concrete): Provide products complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, certified by curing compound manufacturer to not interfere with bonding of sealers, with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements.

D. Clear, Waterborne (Colored Concrete): Provide products that are acceptable to concrete color pigment manufacturer complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, certified by curing compound manufacturer to not interfere with bonding of sealers with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
   1. Products: Subject to compliance with requirements.

E. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
   1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
   2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.06 SEALERS AND WATER REPELLENTS

A. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Clear, chemically reactive, water-based lithium quartz water-based lithium materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide products with 0g/L volatile organic content.
   1. Products: Subject to compliance with requirements, provide one of the following:

a. Sinak Corporation; Concrete Sealer HLQ 125.

B. Penetrating Liquid Wall and Vertical Surface Treatment (Repellent): Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide products with less than 100g/L volatile organic content.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Rainguard International; Microseal(For use with VandlGuardTEN Anti-graffiti coating)

2.07 **ANTI-GRAFFITI COATING**

A. Refer to Section 099620 Permanent Non-Sacrificial Anti-Graffiti Coating for product and specific sealer.
1. Compatible sealer to be applied prior to use of Anti-graffiti coating.

2.08 JOINT DEVICES, FILLER MATERIALS AND OTHER ACCESSORY PRODUCTS

A. Joint Filler at Exterior Sealed Joints: ASTM D 1751
1. Lightweight, nonstaining, polyethylene closed cell expansion joint filler
a. Deck-O-Foam as manufactured by W.R.Meadows, Hampshire, Ill.
2. Exterior Expansion- and Isolation-Joint-Filler Strips: See Division 32 Section "Concrete Paving Joint Sealants" for sealants for exterior joints at concrete pavements.

2.09 REPAIR MATERIALS

A. General: Provide cementitious materials, coarse aggregates, fine aggregates, water, bonding agents and admixtures as required to prepare repair grouts that will match as-cast and site finished architectural site concrete.
1. Maintain accurate records of repair materials and mixtures used on accepted mockups.

B. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
1. Products: Subject to compliance with requirements, provide one of the following:
a. W.R. Meadows, Inc.; Acry-Lok.
b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
c. Larsen Products Corp., "Weld-Crete".
2. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete and for anchoring dowels to hardened concrete.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of cast-in-place architectural site concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
2. Proportioning:
a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.

c. Fine aggregate volume shall be at least 35 percent, with a maximum of 50 percent, of the sum of the separate fine and coarse aggregate volumes.
d. Total water content shall not exceed 35 gallons per cubic yard of concrete.
e. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
f. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.

3. Prepare compressive strength data for both 7-day and 28-day strengths.
   a. The 7-day compressive strength shall be at least 60 percent of the required 28- day strength.
   b. The 28-day compressive strength shall be as indicated.
4. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.

B. Proportion concrete mixtures as follows:
1. Minimum Compressive Strength (28 Days): 3000 psi.
   a. Provide the following minimum compressive strength (28 days) where required by high-pressure water or bush hammer finishing techniques: 4500 psi.
2. Maximum Water-Cementitious Materials Ratio: 0.50-0.60.
3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.
4. Slump Limit (High-Range Water-reducing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch, unless indicated otherwise.
5. Slump Limit (Plasticizing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding plasticizing admixture, plus or minus 1 inch, if required/unless indicated otherwise.

C. Slump Limit: [4 inches (100 mm)] [8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture], plus or minus 1 inch (25 mm), unless otherwise indicated.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.
2. Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
   a. Use [water-reducing] [high-range water-reducing] [or] [plasticizing] admixture in concrete, as required, for placement and workability.
   b. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with accepted mockup.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
1. Splices: Do not splice bars, unless indicated on the Drawings.
2. Staggered Splices: Stagger splices such that not more than one-half of the reinforcing bars are spliced at any location.

2.12 CONCRETE MIXING

A. Ready-Mixed Architectural Site Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M [and ASTM C 1116/1116M] and furnish batch ticket information.
1. Clean equipment used to mix and deliver cast-in-place architectural site concrete to prevent contamination from other concrete.

2. When air temperature is between 85 and 90 deg. F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F, reduce mixing and delivery time to 60 minutes.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.01 FORMWORK

A. General: Comply with the following, unless otherwise indicated:
   1. Conform to ACI 318, ACI 347 and CBC Section 1906A.

B. Structural Loads: Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

C. Geometry: Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Provide for necessary openings, inserts, anchorages, and other features indicated or required. Properly locate all elements.
   1. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
      a. Class A, 1/16 or 1/8 inch for smooth-formed finished surfaces.

D. Form Joints: Minimize form joints and make forms watertight to prevent leakage of concrete mortar. Locate form joints at exposed concrete symmetrically about center of panel and aligned with reveals, unless otherwise indicated. Align joints symmetrically at exposed conditions.
   1. Seal penetrations at form ties with form joint sealant to prevent cement paste leakage.
   2. Provide custom form boards as required to align with reveals.

E. Removal: Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where dismantling or stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Chamfers: Chamfered edges are not allowed.

3.02 EARTH FORMS

A. General: Unless indicated, placement of concrete directly against soil or earth (casting "neat") shall not be permitted only with the prior approval of the Structural Engineer of Record. Concrete placed directly against earth shall require a minimum increase in concrete thickness of 1" at vertical faces. For example, footings shall be 2" wider than indicated if both vertical faces are cast against earth.

B. Trimming and Cleaning: Hand trim sides and bottoms of soil forms and trenches. Remove loose soil, exposing undisturbed native soil, and prior to placing concrete.

3.03 CONSTRUCTED FORMWORK

A. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

B. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

C. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

D. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

E. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

F. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

G. Provide bracing and shores to ensure stability of formwork and accommodate all loads. Use form ties of sufficient strength and in sufficient quantities to prevent formwork spreading. Maintain principal shores to support concrete until required strength is achieved.

3.04 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install embedded accessories level, true-to-line and plumb in accordance with manufacturer's instructions.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   3. Provide reveals around embedded items such as light fixtures as shown on Drawings.

3.05 OPENINGS, DEPRESSIONS, RECESSES AND CHASES

A. Size and locate formed openings, depressions, recesses and chases to accommodate products to be applied to, built-into and/or pass-through concrete Work. Coordinate size, location and placement of inserts, embedded products, openings and recesses with Work of other sections. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.06 FORM RELEASE AGENTS

A. General: Provide either form materials with factory-applied non-absorptive liner or field-applied form coating. Field-applied coating shall be non-staining.
   1. Non-absorptive Liner: Rust on steel form surfaces is not acceptable.
   2. Field Applied Coating: Comply with manufacturer's written instructions. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
      a. Reapply coating to thoroughly cleaned and reconditioned formwork before each use.
      b. Verify compatibility of release agents with integrally-colored concrete and all subsequently applied curing compounds, coatings, applied finishes, etc. Do not apply release agent if items are non-compatible.

c. Do not apply release agent where decorative wood graining is intended for concrete surface. Leave form face dry.

3.07 CONCRETE SURFACE RETARDERS

A. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

3.08 FORM LINERS

A. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.09 REMOVING AND REUSING FORMS

A. General: Formwork for sides of walls, steps, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg. F for 72 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Schedule form removal to maintain surface appearance that matches accepted mockups.
   2. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength, but not less than 21 days after pour.
   3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
   4. All formwork is to be new specifically purchased for this project.

B. Clean and repair surfaces of forms to be reused in the Work in non-exposed areas. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.10 STEEL REINFORCEMENT

A. General: Place and secure reinforcement as indicated. Comply with CRSI publications "Manual of Standard Practice" and "Placing Reinforcing Bars".
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
   2. Do not bend bars more than once.
   3. Do not bend or straighten reinforcement in a manner injurious to the material, such as heating.
   4. Do not use bars with kinks or bends not indicated.
   5. Do not use bars with reduced cross-section due to corrosion or other cause.
   6. Remove and replace all defective bars.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Space reinforcement as indicated. If not indicated, maintain clear spacing of not less than the bar diameter, 1-inch, or 1-1/3 times the maximum aggregate size, whichever is greater. Where parallel reinforcing is placed in more than one horizontal layer, place as many bars as possible in the outboard layer, maintaining the required lateral clearances and spacing's. Place bars in the inboard layer in direct vertical alignment with the bars of the outboard layer. Maintain not less than 1-inch or the maximum bar diameter in the inboard/outboard layers, whichever is greater, clear space between vertically stacked bars.

D. Accurately position, support, and secure reinforcement against displacement.
   1. Maintain reinforcing steel positions during placement operations. Properly reset any reinforcement that is displaced by runways, workmen and other causes.

E. Locate and support reinforcement with bar supports to maintain minimum concrete cover as indicated or as required by ACI 318.

F. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

H. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.11 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction or Cold Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Locate horizontal joints in walls and columns as indicated.
   3. Space vertical joints in walls as indicated and as may be directed by the Architect. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   6. Align joints with reveals indicated. Provide custom cut form boards as required.
   7. Do not place expansion material at cold joints.

C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, walls and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.12 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, surface retarders, reinforcement, and embedded items is complete and that required inspections have been performed.
   1. Provide protective coatings, coverings and masking's to protect adjacent Work.
   2. Provide temporary runways and other appropriate equipment as necessary to access Work area and to avoid soiling or damage to existing Work.
   3. Prevent run-off of concrete hydration water and water polluted by agents and chemicals from soiling existing surfaces or contaminating landscape areas.

B. Do not add water to concrete during delivery, at Project site, or during placement.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
   2. If indicated in mix design accepted by the Architect, water added to concrete shall be observed by the Project Inspector, and shall be recorded on the delivery ticket.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. No visible cold joints or lift lines are acceptable in the completed work.
   3. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
   4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
   5. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   6. Maintain reinforcement in position on chairs during concrete placement.
   7. Screed slab surfaces with a straightedge and strike off to correct elevations.
   8. Slope surfaces uniformly to drains where required.
   9. Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg. F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
   4. Do not use chemical accelerators unless otherwise specified and accepted in design mixtures.

F. Hot-Weather Placement: Comply with ACI 305R and as follows:

1. Maintain concrete temperature below 90 deg. F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.13 FINISHES, GENERAL

A. Architectural Site Concrete Finishes: Match accepted mockups to satisfaction of Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
   1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.14 AS-CAST FORMED FINISHES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects to match the accepted mockups. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding specified limits on formed-surface irregularities.

3.15 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 305R for hot-weather protection during curing.

B. Begin curing cast-in-place architectural site concrete immediately after removing forms from concrete or after applying as-cast formed finishes to concrete, consistent with mockup preparation. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
   1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural site concrete continuously moist for no fewer than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for no fewer than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
   3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the CBC and ACI 301.
   1. Comply with the requirements of Division 01 Section "Quality Control-DSA".

B. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Headed bolts and studs.
   4. Verification of use of required design mixture.
   5. Structural concrete placement, including conveying and depositing.
   6. Curing procedures and maintenance of curing temperature.
   7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg. F and below and when 90 deg. F and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M.
      a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
      b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
      a. Test one set of two field-cured specimens at 7 days and reserve one set of two specimens for testing at 56 days.
      b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
   7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
   8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.17 DEFECTIVE CONCRETE

A. The following list includes, but is not limited to; concrete that will be deemed to be defective and non-conforming. All such concrete shall be removed and replaced with Work complying with the requirements of the Contract:
   1. Concrete not formed as indicated, not true to alignment indicated, not plumb where intended, not level where intended, not true to level or elevation intended.
   2. Concrete voided or honeycombed, including voids and honeycombs that have been cut, resurfaced or filled without prior approval of the Architect.
   3. Concrete with exposed reinforcement.
   4. Concrete with inadequate cover over reinforcement.
   5. Concrete with embedded foreign objects and debris, including sawdust, wood or metal shavings, nails, cans, trash, etc.
   6. Concrete that does not visually match the accepted mockups [or the designated design reference sample].
   7. Other non-conforming work.

B. All concrete deemed to be defective by the Architect or in non-conformance with the contract documents is to be removed and replaced from expansion joint or cold joint to expansion joint or cold joint at no cost to the owner. Repair defective concrete as directed by the Architect, at no cost to the Owner.

3.18 SEALERS AND REPELLENTS

A. General: Uniformly apply a continuous sealing coat of sealers or repellents to all exposed surfaces of architectural site concrete by power spray or roller according to manufacturer's written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days old.

B. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
   1. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

C. Penetrating Liquid Wall and Vertical Surface Treatment (Sealer/Repellent): Prepare, apply, and finish penetrating liquid repellent treatment according to manufacturer's written instructions.

3.19 **ANTI-GRAFFITI COATING**

A. Refer to Section 099620 Permanante Non-Sacrificial Anti-Graffiti Coating.

B. Apply to all exposed architectual site concrete.

C. Apply compatilble sealer to exposed architectural site concrete prior to installation of Anti-Graffiti coating.

3.20 REPAIRS, PROTECTION, AND CLEANING

A. Patching or sacking of damaged or defective concrete as a determined by the Architect is not permitted. Remove and replace all damaged or defective concrete from joint to joint. Remove/Repair and cure damaged or defective finished surfaces of cast-in-place architectural site concrete when accepted by Architect. Match repairs to color, texture, and for any replaced work/uniformity of surrounding surfaces and to repairs on approved mockups.

B. Remove and replace cast-in-place architectural site concrete that does not match mockups accepted by Architect.

C. Protect corners, edges, and surfaces of cast-in-place architectural site concrete from damage; use guards and barricades.

D. Protect cast-in-place architectural site concrete from staining, laitance, and contamination during remainder of construction period.

E. Clean cast-in-place architectural site concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

F. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.

1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural site concrete finishes.

END OF SECTION

SECTION 328400
IRRIGATION SYSTEM

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; 2020.

B. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

C. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.

D. ASTM D2464 - Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2023.

1.02 SUMMARY

A. The CONTRACTOR shall provide all labor, materials, supplies, tools, and transportation and perform all operations in connection with and reasonably incidental to complete the installation of the automatic sprinkler irrigation systems as shown on the drawings. Items hereinafter are included as an aid to take off, and are not necessarily a complete list of work items.
   1. Keep existing valves operational as required.
      a. Relocate and adjust existing sprinkler heads to achieve and maintain head to head coverage as required.
      b. Trenching, stockpiling, excavation, materials, and refilling trenches.
      c. Furnishing materials and installation for complete system including piping, valves, fittings, sprinkler heads, dripline and fittings, automatic controls, and final adjustment of heads to insure complete coverage.
      d. Line voltage connections to the irrigation controllers and low voltage control wiring from controllers to remote control valves.
      e. Replacement of unsatisfactory materials.
      f. Re-sod or seed all irrigation trenches through existing sod areas.
      g. Clean-up, inspection and approval.
      h. All work of every description mentioned in the specification and/or addenda thereto, all other labor, and materials reasonably incidental to the satisfactory completion of the work, including clean-up of the site, as directed by the Project Representative.
      i. Tests.
      j. As-built record drawings.

B. Work Specified Elsewhere:
   1. Irrigation water stub-out.
   2. 120 volt A.C. electrical stub-out to controller location.
   3. Irrigation piping in structure.
   4. Irrigation sleeves.
   5. Electrical conduit in structure for 24-volt wire.

1.03 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Irrigation System:

1. Measurement: Irrigation system installation is measured on a lump sum basis.
    a. Payment: The contract lump sum price paid for the Irrigation System shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and installing the Irrigation System, complete in place.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer catalog information on all material to be used on the project as specified on the legend, notes, details and plans. Redline or highlight exact items on page to be submitted. Complete material list shall be submitted prior to performing any work.

B. Substitutions: No substitution will be permitted without prior written approval by the Project Representative. If the product is approved and, in the opinion of the Project Representative, the substituted product does not perform as well as the specified product, the Contractor shall replace it with the specified product at no additional cost to the Project Representative.

C. All equipment or materials installed or furnished without prior approval of the Project Representative may be rejected and the Contractor may be required to remove the equipment or material at their own expense.

1.05 CLOSEOUT SUBMITTALS

A. Project As-built Record Documents:
    a. The Contractor shall maintain in good order in the field office, one complete set of black line prints of all sprinkler drawings which form a part of the contract, showing all water lines, electrical, sprinklers, valves, stub-outs. In the event any work is not installed as indicated on the drawings, such work shall be corrected and documented accurately on the working drawings.
    b. Dimension from two permanent points of reference, such as building corners, sidewalks, road intersections or monuments, the following items:
        1) Connection to water source
        2) Backflow preventor
        3) Gate valves
        4) Routing of pressurized mainlines and lateral lines
        5) Remote control valves
        6) Quick coupling valves
        7) Flow sensor, master valve, and irrigation controller
    c. Deliverables shall be one full size colored hard copy of the contract drawings with redlines and dimensions or a full sized colored scanned PDF version.

B. Controller Chart:
    a. Provide one laminated (hermetically sealed between two pieces of 10 mil. plastic) controller chart showing the area covered by controller for each automatic controller supplied at the maximum size controller door will allow. Chart shall be a reduced drawing of the actual "as-built" system. If controller sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside the controller door.
    b. Controller chart shall be a blackline print with a different color used to show area of coverage for each station. Charts must be completed and approved by the Project Representative prior to final inspection of the irrigation system.
    c. Locate all dripline flush valves and dripline indicators on colored plans if the locations differ from design plans.

C. Controller Cloud Based Communication and Flow Sensor installation confirmation:

a. Provide written confirmation that the cloud-based communications are set up and operational between controller(s) and cloud-based server.
b. If controller is a two-wire type controller. Provide confirmation that the controller is communicating with each decoder valve on system and there are no error messages logged on the cloud-based communication system. Provide a printout of information to Landscape Architect or Irrigation Consultant.
c. Provide written confirmation from the distributor/manufacturer's representative that the controller is communicating with flow sensors and that the correct "k" and "offsets" are setup and utilized properly. The “k” and “offsets” are pre-set numbers you plug into the controller software based on the flow sensor size and type when calibrating the flow sensor. Confirm that flow values have been "learned" and recorded for each valve on the controller, and the correct gpm per valve is shown and verified on a printout and provided to Landscape Architect or Irrigation Consultant. Flow alarms and automatic shut offs should be set up after plant establishment.

D. Maintenance and Operating Instructions and Manuals:
a. Contractor shall prepare an Operation and Maintenance Manual, organized in a 3-ring binder, containing the following information.
1) Contractor's name, address, and telephone number. Duration of guarantee, periods as specified herein, list of equipment with names and addresses of local manufacturer’s representatives with duration of written warranties. Complete operating and maintenance instructions on all equipment spare parts lists and related manufacturer's information.
b. Submit the Operation and Maintenance Manual to the Project Representative within 10 Calendar Days of completion of work of this Section and as a condition of project acceptance.

E. Irrigation Audit, Irrigation Survey, and Irrigation Water Use Analysis:
a. All landscape irrigation audits shall be conducted by a local agency landscape irrigation auditor or a third party certified landscape irrigation auditor. Landscape audits shall not be conducted by the person who design the landscape or installed landscape.
b. In large projects or projects with multiple landscape installations (i.e. production home developments) an audit rate of 1 to 7 lots or approximately 15% will satisfy this requirement.
c. For new construction and rehabilitated landscape projects installed after December 1,2015, as described in Section 490.1:
1) The project applicant shall submit an irrigation audit report with the Certificate of Completion to the local agency that may include, but is not limited to: inspection, system tune-up, system test with distribution uniformity, reporting overspray or run off that causes overland flow, and preparation of an irrigation schedule, including configuring irrigation controllers with application rate, soil types, plant factor, slop, exposure and any other factors necessary for accurate programming.

1.06 QUALITY ASSURANCE & GENERAL REQUIREMENTS

A. Qualifications: The Contractor, personally or through an authorized and competent representative, shall supervise the work constantly, and shall as far as possible keep the same foreman and workmen on the job from commencement to completion. The workmanship of the entire job must in every way be first class, and only experienced and competent workmen will be allowed on the job. A minimum of five years’ experience of installing irrigation systems of similar scope, size and complexity as the system being installed under this scope of work is required for all on-site job superintendents.

B. Manufacturer's installation instructions and best practices: Manufacturer's installation instructions shall be followed in all cases when not shown in the Drawings or Specifications.

C. O.S.H.A. Compliance: All articles and services covered by this specification shall meet or exceed the safety standards established under the Federal Occupational Safety and Health Act of 1970, together with all amendments in effect as of the date of this specification.

D. All irrigation systems shall be installed to meet or exceed the requirements set forth in the California Department of Water Resources Model Water Efficient Landscape Ordinance.

E. All materials supplied for this Project shall be new and free from any defects. All defective materials shall be replaced immediately at no additional cost to City.

F. Codes and Standards: Comply with all applicable codes and standards.
   a. All work and materials shall be in full accordance with the latest rules and regulations of the National Electric Code; published by the Western Plumbing Officials Association; California Code of Regulations, Title 23, Division 2. Department of Water Resources, Chapter 2.7. Model Water Efficient Landscape Ordinance; and other State or local laws regulations. Nothing in these drawings or specifications is to be construed as to permit work not conforming to these codes.
   b. When the specifications call for materials or construction of a better quality or larger size than required by the above mentioned rules and regulations, the provision of the specifications shall take precedence over the requirements of said rules and regulations.
   c. Contractor shall furnish, without extra charge, any additional material and labor when required by the compliance with these rules and regulations, though the work be not mentioned in these particular specifications or shown on the drawings.
   d. The Contractor shall erect and maintain barricades, guards, warning signs, and lights as necessary or required by O.S.H.A. regulations for the protection of the public or workmen.
   e. Any existing buildings, equipment, piping, pipe covering sewers, etc., damaged by the Contractor during the course of his work shall be replaced or repaired by the Contractor in a manner satisfactory to the Project Representative and at Contractor's own expense, before final payment is made. The Contractor shall be responsible for damage caused by leaks in the piping systems being installed or having been installed under this contract. He/she shall repair, at his/her own expense, all damage so caused, in a manner satisfactory to the Project Representative.
   f. The Contractor shall secure the required licenses and permits including payments of charges and fees, give required notices to public authorities, verify permits secured or arrangements made by others affecting the Work of this section.

1.07 EXISTING CONDITIONS

A. Protection of Existing Structures and Utilities
   a. The Drawings show, if applicable, existing above and below grade structures and utilities that are known to the Project Representative. Locate known existing installations before proceeding with construction operations that may cause damage to such installations. Existing installations shall be kept in service where possible and damage to them shall be repaired with no adjustment of Contract Sum. Verify with Project Representative if As Built drawings are available.
   b. If other structures or utilities are encountered, request Project Representative to provide direction on how to proceed with the Work. If a structure or utility is damaged, take appropriate action to ensure the safety of persons and property.

B. Trench Interference with Existing Tree Root Systems: Prior to trenching, layout main and lateral line locations within drip Line of trees and review locations with Project Representative. Relocate any lines that may interfere with existing root systems to avoid or reduce damage to root systems as accepted by Project Representative.

C. Provide barricades, coverings, warning signs, lights and other protection required by local code or OSHA to prevent damage to existing improvements to remain and to protect the public.

1.08 DELIVERY, STORAGE AND HANDLING:

A. Protection: Use all means necessary to protect irrigation system materials before, during and after installation and the installed work and materials of all other trades.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the satisfaction of the Project Representative and at no additional cost to the project.

a. Exercise care in handling, loading, unloading and storing plastic pipe and fittings under cover until ready to install; transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load. Protect pipe from sunlight.

b. Repair all dented and damaged pipe by cutting out the dented or damaged section and rejoining with a coupling.

1.09 LAYOUT OF WORK

A. The Contractor shall stake out the irrigation system as shown on the drawings. These areas shall be checked by the Contractor and Project Representative before construction is started. Any changes, deletions or additions shall be determined at this check.

B. Due to the scale of the Drawings, it is not possible to indicate all piping offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affected all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities and architectural features.

C. Do not install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in arc dimensions exist that might not have been considered. Bring such obstruction or differences to the attention of the Project Representative. Notify and coordinate irrigation Work with applicable contractors for location and installation of piping and sleeves through or under walls, pavement and structures. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary.

1.10 SEQUENCING AND SCHEDULING

A. Acceptance: Do not install main line trenching prior to acceptance by Project Representative of rough grades completed under another Section.

B. Coordination: Coordinate with all other trades: the sleeving, power requirements of the project, prior to the start of construction.

1.11 EXISTING IRRIGATION SYSTEM

A. This Contract requires that the existing irrigation system be kept intact on all areas of the park not yet worked on to permit normal watering during construction. On areas that have been installed according to these plans and specifications, irrigation shall be programmed to operate via the controller. On areas being worked on, the Contractor shall afford the City every opportunity to hand water during the period of shutdown with particular emphasis on the ballfields

B. After the new irrigation system is fully functional, all existing sprinklers, valves, valve boxes, and quick coupling valves in the work areas will be removed by the Contractor. Fill all void with backfill material leaving 6” near the surface for topsoil. Compact by mechanical tamping to a minimum compaction of 85% relative compaction. Add a minimum of 6” of topsoil to compacted backfill. The topsoil shall be placed and blended to the satisfaction of the Project Representative. In turf areas, re-seed the topsoil with an approved seed mix.

1.12 INSTRUCTION

A. After the system has been installed and approved, the Contractor shall instruct the Project Representative and or Maintenance Contractor, in complete operation and maintenance of the irrigation system.

PART 2 MATERIALS

2.01 PIPE AND FITTINGS

A. PVC Pressure Mainline pipe and fittings.
   1. Pressure mainline piping:
      1) 3” AND SMALLER: Shall be PVC 1120-Schedule 40 plastic pipe. Pipe shall be made from NSF approved Type 1, Grade 1 PVC compound conforming to ASTM D1785.
      b. Schedule 40 pipe shall be manufactured in strict compliance to ASTM D1785 and D2665 (where applicable), consistently meeting and/or exceeding the Quality Assurance test requirements of these standards with regard to material, workmanship, burst pressure, flattening, and extrusion quality.
   2. All PVC pipe shall bear the following markings:
      a. Manufacturer’s name
         1) Nominal pipe size
         2) Class or Schedule
         3) Pressure rating in PSI
         4) NSF
         5) Date of extrusion
      b. Use solvent weld pipe for mainline pipe with a nominal diameter less than 3-inches or where a pipe connection occurs in a sleeve. Use Schedule 40 Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 at changes in direction or branch mains. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564.
      c. Connections between main lines and RCV’s shall be of Schedule 80 PVC (threaded both ends) nipples and fittings.
      d. All fittings shall bear the manufacturer’s name or trademark, material designation, size, applicable I.P.D. schedule and NSF Seal of approval.
      e. Inside diameter of pipe shall be the same size as iron pipe.
      f. PVC Type I shall not be threaded.
      g. PVC fittings shall be PVC Type II, Schedule 40 NSF approved.
      h. Caution shall be utilized in handling Type I pipe due to the possibility of cracking or splitting.
      i. When connection is plastic to metal, male adapters shall be used unless otherwise noted or detailed. The Male adapter shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base (Teflon paste or equal).
      j. Threaded Nipples – ASTM D2464, Schedule 80 with molded threads.

B. PVC Non-pressure lateral line and fittings

a. Lateral lines (non-pressure): 3/4” and larger shall be Schedule 40 PVC plastic pipe.
b. Manufactured from virgin polyvinyl chloride (PVC) compound in accordance with ASTM D2241 and ASTM D1784; cell classification 12245-B, Type 1, Grade 1.
c. Fittings – All lateral lines shall be connected with Schedule 40, Type I, Grade I, PVC solvent weld fittings.
d. Threads – Injection molded type (where required).
e. Tees and ells – Side gated.
f. Threaded Nipples – ASTM D2464, Schedule 80 with molded threads.
g. Refer to “trenching and backfilling” elsewhere in these specifications for minimum depths.

C. Solvent for all PVC pipe shall be #711 Gray, along with #P-70 primer, NSF approved as manufactured by Industrial Polychemical Service, Gardena, California, or approved equal.

D. Pipe joint compound shall be non-hardening, non-toxic materials designed specifically for use on threaded connections in water carrying pipe. Performance shall be same as RectorSeal #5.

E. PVC Flexible Pipe: Extruded from flexible vinyl chloride compound.
1. ½ inch pipe: 0.50 inch inside diameter, 0.090 inch wall thickness
2. Material shall conform to ASTM designation D-2287.

F. Swing joints shall be as shown on construction details.

2.02 SLEEVES

A. Sleeve below all hardscape elements with SCH 40 or Class 200 PVC twice the diameter of the pipe or wire bundle within, or as delineated on the plans.

B. Under Hardscape Crossings: Sleeves shall extend a minimum of 24 inches beyond all sidewalks, or shall be extend 24” beyond the back edge of the curb, where noted on the plans.

2.03 MASTER CONTROL VALVE

A. Master control valve shall be a normally open 24 VAC solenoid actuated globe pattern valve.

B. Valves shall be made of brass with a minimum pressure rating of 150 PSI

C. Valve shall have external and internal bleed for manual operation.

D. Valve model and size shall be as shown on drawings.

2.04 FLOW SENSORS

A. Inline flow sensors shall be installed in accordance with the manufacturer’s installation instructions. Contractor is responsible for the installation, all required materials and connections of the flow sensors for complete operation with the irrigation controller.

B. Flow sensor size and model shall be listed on the drawings.

2.05 FLOW SENSOR CABLE AND CONDUIT

A. Flow sensor wire shall be shielded cable Paige model 7171D or approved equal.

B. Maximum cable distance from controller to flow sensor shall be 2000 feet

C. Install flow sensor cable in a 1” grey SCH 40 PVC conduit with long sweep elbows.

D. Conduit and flow sensor cable shall be routed with mainline wherever possible. Provide a minimum 6” separation between conduit and pressure main line.

E. Provide 10” round gray electrical pull boxes a minimum of every 200, feet at each change in direction and adjacent to each controller. Heat brand lid of pull box “FSB”.

2.06 GATE VALVES

A. Gate valves 3” and smaller shall meet the following requirements:
   a. Valves shall be of stainless steel (304 or higher) or bronze/brass construction with non-rising stem, cross handle and threaded connections.
   b. Valves shall be Leemco Model #LGT-SS, Nibco T-113-K or approved equal. Size as shown on the drawings
   c. Install in 10” diameter plastic valve box as detailed.

2.07 QUICK COUPLING VALVES

A. Quick coupling valves shall be as shown on the drawings.
B. Install in 10” diameter plastic valve box as detailed.

2.08 CONTROLLERS

A. Controller’s size and model shall be as listed on the drawings.
B. Final location(s) of controller shall be approved by the Project Representative.
C. Controller requires 120v power. Maximum power output of controller is 2.5 amps.
D. Install Controller and accessories as detailed and per Manufacturer’s details.

2.09 TWO WIRE CABLE

A. Irrigation control wires: solid copper with U.L. approval for direct burial in ground. Size #14awg wire with a jacketed 2-conductor. Preferred wire make and model is the Paige irrigation wire or approved equal. All splicing shall be made with 3-M DBR/Y-6.
B. Two wire cable shall be installed within 1¼” Schedule 40 grey PVC with Schedule 40 fittings and Schedule 40 electrical long sweeps elbows at all changes in direction. Pull boxes shall be located a maximum of 250 feet on center, adjacent to controller, and at each change of direction.

2.10 CONDUIT PULL BOXES

A. In Landscaped Areas: Conduit pull boxes shall be Carson Model 1419, or approved equal plastic valve box with a lockable plastic lid. Color shall be Gray and lockable. Heat brand box “PB”. Text height of letters to be 2”.
B. In concrete: All irrigation pull boxes placed in concrete surfacing, shall be high density reinforced concrete, with a steel checker plate, bolt-down lid, placed on a concrete footing, and marked “Irrigation”, dependent upon the utility housed within. Acceptable products shall be Christy N-9, Brooks, Quickset, or approved equal. Covers shall have cast brass hold-down lugs.
C. Pull boxes along a long conduit run shall be no more than 250 feet apart.
D. Each pull box shall be set on 6 inches, minimum, of clean drain rock.
E. Pull boxes shall be placed at all angle points in conduit runs.

2.11 ELECTRIC REMOTE CONTROL VALVES

A. Electric remote control valves sizes shall be shown on drawings.
B. Electric remote control valve shall be a normally closed 24 VAC solenoid actuated globe pattern valve.
C. Valves shall be made of durable glass-filled nylon iron with a minimum pressure rating of 150 PSI

D. Valve shall have external and internal bleed for manual operation.

E. Where shown on details, all valves shall have one Schedule 80 PVC FIPT threaded true union ball valve with EPDM O-rings on the upstream side of valve and one Schedule 80 union on the downstream side of valve. Ball valve shall be IPEX VXE series, Asahi Type 21 or equal. Match valve size when sizing ball valve and union.

F. All valves that service dripline or drip systems shall include a plastic wye filter and pressure regulator on the valve or a solid set 40 PSI plastic regulator downstream of the valve. Filters shall be rated to 120 psi, includes a 150 mesh disk or stainless steel screen.

2.12 IDENTIFICATION TAG

A. Identification tags for all electric control valves shall be manufactured by Christy. Tag numbers shall match stationing in controller and as shown on as-built drawings. Provide one yellow station number tag for each electric control valve:
   1. Potable water systems: Christy ID.STD.Y1

2.13 VALVES BOXES

A. ELECTRIC REMOTE CONTROL VALVE BOXES:
   a. All electric remote control valve boxes that service non-drip systems shall be installed within a Carson model 1419 (14”x19”) or 1220 (13” x 20”) plastic valve box with bolt down plastic lid or approved equal. Size of box is dependent on the size of valve. Lid shall be marked: "Irrigation Control Valve."
   b. All electric remote control valve boxes that service dripline or drip systems shall be installed within a Carson model 1220 plastic valve box with bolt down plastic lid or approved equal. Lid shall be marked: "Irrigation Control Valve."
   c. Use black colored boxes in shrub and groundcover areas and green in turf areas.
   d. Heat brand controller letter and numbers into lid. Minimum text height to be 2”.

B. GATE VALVE AND QUICK COUPLING VALVE BOXES:
   a. All gate valve and quick coupling valve shall be installed within a Carson Model 910-18” depth plastic valve box with plastic lid or approved equal. Use 8” or 10” sleeve to encase gate valve.
   b. Use black colored boxes in shrub and groundcover areas and green in turf areas.
   c. Heat brand the letters “GV” into lid. Minimum text height to be 2”.

C. DRIP COMPONENT BOXES:
   a. All drip components shall be installed within a 6” round black plastic valve box with plastic lid. Carson Model 708 plastic valve box with plastic lid or approved

2.14 SPRINKLER HEADS

A. All sprinkler heads shall be as listed on the drawings.

B. Pop-up spray sprinklers shall include a built in check valve in the body to hold up to 14 feet of head.

C. Pop-up spray sprinklers shall include built in pressure regulation in the body.

D. Use 30 psi regulators for all spray nozzles and 45 psi regulators for all rotating nozzles. Use 12” pop-ups in shrub and ground cover areas and 6” pop-ups in turf areas.

E. Riser units and nipples shall be the same size as the inlet to the sprinkler body.

2.15 BUBBLERS

A. Bubblers shall be as listed on the drawings.

B. Bubblers shall be pressure compensating from 20 psi to 60 psi.

C. The bubbler body shall be manufactured with UV Stabilizers and have ½" FIPT threads for connection to ½" MNPT male adaptor or nipple.

D. Flow rate molded onto the bubbler for easy identification

E. Where low head drainage occurs, each bubbler shall have a check valve installed. Hunter HC-50F-50M or approved equal.

2.16 DRIPLINE & DRIPLINE COMPONENTS

A. Dripline shall be as listed on the drawings.

B. Tubing shall be low density, UV resistant, polyethylene tubing with internal pressure-compensating, drip emitters impregnated into the tubing spaced at 12 or 18 inches

C. The built in emitters shall be capable of delivering 0.6 gallons per hour per emitter.

D. All dripline systems shall have a manual flush valve at each isolated zone within the systems. Multiple flush valves may be required per drip zone.

E. All dripline systems shall have air relief valve(s) at the highest elevation point(s) within each isolated zone. Install one air relief valve for every 500 linear feet of dripline.

F. Use purple colored tubing for recycled water systems.

2.17 MISCELLANEOUS INSTALLATION MATERIALS

A. Solvent cement and primer for solvent weld joints shall be of make and type approved by manufacturer(s) of pipe and fittings. Cement shall be maintained at proper consistency throughout use.

B. Pipe joint compound shall be non-hardening, non-toxic materials designed specifically for use on threaded connections in water carrying pipe. Performance shall be same as RectorSeal #5.

2.18 MISCELLANEOUS EQUIPMENT

A. Provide all equipment called for by the drawings.

B. Provide to the Project Representative at completion of the maintenance period, three (3) each of all operating and servicing keys and wrenches required for complete maintenance and operation of all heads and valve. Include all wrenches necessary for complete disassembly of all heads and valves.

PART 3 INSTALLATION

3.01 PREPARATION

A. Schedule and coordinate placement of materials and equipment in a manner to effect the earliest completion of work in conformance with construction and progress schedule.

3.02 HANDLING AND STORAGE

A. Protect work and materials from damage during construction and storage as directed by the Project Representative.

B. Handle plastic pipe carefully; especially protect it from prolonged exposure to sunlight. Any section of pipe that has been damaged will be discarded and removed and replaced if installed.

3.03 LAYOUT

A. Lay out work as accurately as possible in accordance with diagrammatic drawings.

B. Where site conditions do not permit location of piping, valves and heads where shown, notify Project Representative immediately and determine relocation in joint conference.

C. Prior to installation, the Contractor shall stake out the routing of all pressurized main lines and sprinkler heads for approval by Project Representative.

D. Run pipelines and automatic control wiring in common trenches wherever practical.

3.04 EXCAVATING AND TRENCHING

A. Work shall be performed when soils are reasonably dry and not saturated.

B. Trenching
   a. Excavations shall be open vertical construction sufficiently wide to provide free working space around the work installed and to provide ample space for backfilling and compacting.
   b. In existing turf areas remove sod with sod cutter. Roll and set aside. Replace immediately after installing conduit (three days maximum), backfilling and compacting.
   c. Depth of trenches shall be pipelines deep enough to provide minimum cover from finish grade as follows.
      1) 24” or 18” minimum cover over main lines to control valves and quick coupling valves. Refer to legend for depth requirements.
      2) 24” or 18” minimum cover over control wires from controller to valves. Refer to legend for depth requirements.
      3) 18” - 12” minimum cover over RCV controlled lateral lines to sprinkler heads. 18” depth will be required at all 12” pop-up sprinklers. Refer to legend for depth requirements.
   d. Trenches shall be excavated to such depths as will permit the pipe to be laid at the elevations, slopes, or depths of cover indicated on the drawings, and at uniform slopes between indicated elevations.
   e. Whenever cobbles larger than 2 inches in size are present in earthen subgrade, the trench section shall be excavated to the lines required. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated. Trenches shall be excavated with approximately vertical sides between the elevation of the bottom of the pipe and an elevation one foot above the top of the pipe.
   f. When two pipes are to be placed in the same trench, maintain a 4” space between pipes as minimum.
   g. Where other utilities interfere with irrigation trenching and pipe work, adjust the trench depth as instructed by the Project Representative.
   h. Restore surfaces, existing underground installations, etc., damaged or cut as a result of excavations, to original conditions in a manner approved by the Project Representative.

C. Backfilling:
   a. Backfill materials shall be approved native soil in all landscaped areas. Unsuitable material, including clods and rocks over 2inches in size shall be removed from the premises by Contractor and disposed of legally at no cost to the Project Representative.
   b. Backfill only after piping has been tested, inspected and approved.
   c. Place backfill materials in 6” layers and compact by jetting or tamping to a minimum compaction of 90 percent of original soil density.

d. Dress off areas to finish grades and remove excess soil, rocks or debris remaining after backfill is completed.
e. All backfilling shall be properly compacted so as to avoid future settlement.
f. If settlement occurs along trenches, and adjustments in pipes, valves and sprinkler heads, soil, sod or paving are necessary to bring the system, soil, sod or paving to the proper level or the permanent grade, the Contractor, as part of the work under this contract, shall make all adjustments without extra cost to the project.

D. Re-sod Turf Areas
a. The contractor shall sod cut all existing turf areas that require trenching. Keep existing sod cuts moist and relay rolls as quickly as possible to prevent loss and stress.
b. If sod cut turf does not survive, Contractor shall re-sod any turf areas damaged due to trenching, excavation, or equipment damage such as tire tracks, to the satisfaction of the Project Representative. If approved by Project Representative re-seeding of damaged areas may be allowed.
c. Contractor shall furnish topsoil approved by the Project Representative in sufficient quantities needed to perform the work and feather in all edges to eliminate any lips.
d. Sod shall be placed over the top of all excavations through grass areas. Backfill of trenches should be held short of adjacent finished grade by 1/2 inch, minimum, to accommodate sod. Roll sod with a roller to eliminate any lips where existing and new sod transition.
e. If necessary, the edge of new sod and existing turf shall be blended by using a topsoil on the turf surface to eliminate the lip. The topsoil shall be placed and blended until the lip has been blended to the satisfaction of the Project Representative.
f. Roll sod after installation, a minimum of 3 passes, to remove air pockets and promote establishment of sod.

3.05 INSTALLATION OF SLEEVING UNDER ASPHALT OR CONCRETE

A. General: Layout of the piping system shall be per the drawings and to the depth specified above.

B. Under Existing Pavement:
a. Piping under existing pavement may be installed by jacking, boring or hydraulic driving, except that no hydraulic driving will be permitted under asphaltic concrete pavement.
b. Where cutting of existing pavement is necessary, provide alternate routes for vehicular traffic. After placement of pipes, backfill trench and compact to 95%. Replace entire section of base rock and hardscape to match existing conditions.

C. Inspection of Pipe and Fittings: Carefully inspect all pipe fittings before installation, removing all dirt, scale and burrs; ream as required. Install all pipe with all markings up for visual inspection and verification.

D. Installation of Sleeving:
a. Sleeving shall be installed a minimum of 24 inches below grade.
b. Sleeving shall extend 24 inches beyond the edge of finished concrete surface.

c. Trenches containing sleeves shall be backfilled with material that consists of unwashed creek or bank gravel, crushed grave, crushed rock, sand or a mixture of these materials. If must be free from roots, vegetable matter or other deleterious substance and shall be of such nature and so graded that it will bind readily when watered and compacted. Backfill with such material to the bottom of the concrete or hardscape section and compacted to a minimum of 90%. Where the sleeve extends beyond the edge of the hardscape or concrete, the sleeve shall be backfilled with native soil or imported topsoil, which ever is specified. If nothing is specified, use previously excavated native soil.
d. Prior to placement of concrete, the ends of the sleeves shall be marked with a stake that shall be exposed approximately 2”-3” above rough, or finished grade to identify sleeve locations. On all street crossing, the location shall be marked at the edge of concrete or hardscape with a chiseled line or “x”, and the stake removed.

3.06 ASSEMBLING PIPELINES

A. PVC pipe shall be installed in a manner which will provide for expansion and contraction as recommended by the pipe manufacturer. Pipe routing is diagrammatic and shall be installed in such a manner as to conform with the details.

B. In joining, use only the specified solvent and make all joints in strict accordance with the manufacturer's recommended methods. Give solvent welds at least 16 minutes set-up time before moving or handling and 24 hours curing time before filling with water.

C. All pipe shall be assembled free from dirt and pipe scale. Field cut ends shall be reamed only to full pipe diameter with rough edges and burrs removed.

D. Install 3” wide detectable warning tape above all pressurized main lines as shown in the details. Use Christy model #TA-DT-3-BIRR for potable irrigation systems.

E. Solvent Weld Joint:
   a. Prepare joint by first making sure the pipe end is square. Then, de-burring the pipe end, and clean pipe and fitting of dirt, dust and moisture.
   b. Dry insert pipe into fitting to check for proper sizing. Pipe should enter fitting 1/3 to 2/3 depth of socket.
   c. Coat the inside socket surface of the fitting and the male end of the pipe with P-70 primer (manufactured by Weld-On). Then without delay, apply Weld-On 711 cement liberally to the male end of the pipe and also apply 711 cement lightly to the inside of the socket. At this time, apply a second coat of cement to the pipe end.
   d. Insert pipe immediately into fitting and turn 1/4 turn to distribute cement and remove air bubbles. The pipe must seat to the bottom of the socket and fitting. Check alignment of the fitting. Pipe and fitting shall be aligned properly without strain to either.
   e. Hold joint still for approximately thirty (30) seconds and then wipe the excess cement from the pipe and fitting.
   f. Cure joint a minimum of thirty (30) minutes before handling, at least six (6) hours before allowing water in the pipe.

F. Threaded Joint:
   a. Field threading of plastic pipe or fittings is not permitted. Only factory formed threads will be permitted.
   b. Factory made nipples shall be used wherever possible. Field cut threads in metallic pipe will be permitted only where absolutely necessary. When field threading, cut threads accurately on axis with sharp dies.
   c. All threaded joints shall be made up with pipe joint compound. Apply compound to male threads only.

d. Where assembling metallic pipe to metallic fitting or valve, not more than three (3) full threads shall show when joint is made up.
e. Where assembling to threaded plastic fitting, take up joint no more than one full turn beyond hand tight.
f. Where assembling plastic pipe, use strap type friction wrench only; do not use metal-jawed wrench.

G. Cap or plug openings as pipeline is assembled to prevent entrance of dirt or obstructions. Remove caps or plugs only when necessary to continue assembly.

H. Where pipes or control wires pass through sleeves, provide removable non-decaying plug at ends of sleeve to prevent entrance of earth.

I. For plastic-to-steel connections, work the steel connections first; use a non-hardening non-lead base pipe dope on all threaded plastic-to-steel connections and use only light wrench pressure. All plastic-to-steel connections shall be made with SCH 80 PVC nipple or plastic male adapters.

3.07 REMOTE CONTROL VALVES

A. Install where shown on drawings and group together where practical. Limit one remote control valve per box.

B. Locate valve boxes 12” from and perpendicular to walk edges, buildings and walls. Provide 12” between valve boxes where valves are grouped together.

C. Thoroughly flush main line before installing valves.

D. Install in shrub or groundcover areas where possible.

E. Label control line wire at each valve with an I.D. tag, indicating identification number of valve (controller and station number). Attach label to control wire.

F. Flow control stems shall be adjusted or tuned per manufacturer recommendations.

G. Install 18GA ½” x ½” square hot dipped galvanized wire mesh under all valve boxes and wrap up the sides of the valves. Adhere wire mesh to sides of box with stainless-steel screws and washers as required. Refer to details for more information.

3.08 TWO WIRE CABLE

A. Run lines along mains wherever practical.

B. Loop a minimum of two (2) feet of extra wire in each valve box.

C. Connections shall be made by crimping bare wires with brass connectors and sealing with watertight resin sealer packs per manufacturer specifications.

D. Splicing will be permitted only at valve/decoder connections and at main line tee branches. Do not splice in wire pull boxes. Locate all splices within valve boxes or in a two wire splice box.

3.09 TWO WIRE CABLE IN CONDUIT:

A. Install cable in PVC electrical conduit with pull/splice boxes located as shown on plans and as required. This conduit shall be dedicated to irrigation control wires only.

B. For all cable runs, pull/junction boxes will be required every 250 linear feet of conduit run.

C. All electrical equipment and wiring shall comply with local and state codes and be installed by personnel skilled and licensed in the trade.

D. Connecting and splicing of wire at the valves shall be made using approved materials and shall be made by crimping bare wires with brass connectors and sealing with watertight resin sealer packs. 3M DBY-6 or approved equal.

E. All splices shall be placed within a valve box. Leave a 24” long coil, at each pull box, or splice location.

3.10 AUTOMATIC CONTROLLER

A. Provide and install automatic irrigation controller in approximate locations shown on drawings. The exact location will be determined on the site by the Project Representative. Provide conduit and wire and connect to 120 volt switch accessible to controller for ease of maintenance.

3.11 SPRINKLER HEADS AND BUBBLERS

A. All sprinkler heads shall be set perpendicular to finish grade of the area to be irrigated unless otherwise designated on the plans.

B. In lawn areas, all sprinkler heads shall be offset a minimum of 3 inches and a maximum of 6 inches from the edge of adjacent hardscape.

C. Flush and adjust irrigation outlets, bubblers and nozzles for optimum performance and to prevent overspray onto field, walks, roadways, and/or buildings as much as possible. This shall include selecting the best degree of arc and radius to fit the existing site conditions and throttle the flow control at each valve to obtain the optimum operating pressure for each control zone.

D. Install lawn heads 1” above grade in seeded lawn area at time of installation. Lower to finished grade after turf is well established and as directed by Project Representative.

3.12 QUICK COUPLING VALVES

A. Thoroughly flush lines before installing quick coupling valves.

B. Locate quick coupling valves as shown in the drawings and details.

C. Locate valve boxes 12” from and perpendicular to walk edges, buildings and walls. Provide 12” between other valve boxes where valves are grouped together.

3.13 DRIPLINE AND DRIPLINE COMPONENTS

A. Thoroughly flush all driplines.

B. Install dripline a minimum of 12” away from all buildings and 6” off hardscapes for shrubs and groundcover. 2” of paving for all no-mow or sod type grasses.

C. Space driplines equally throughout the planting area as detailed. Refer to legend for emitter and row spacing of dripline. Adjust alternate rows so emitters are spaced in a triangular pattern.

D. All dripline tubing shall be buried 4” below finish grade and stapled down every 4’ and at each change in direction with a 6” tubing stake.

E. For slopes greater than 10:1, modify dripline row spacing on the bottom 1/3 of the slope to be 25% greater at the bottom of the slope.

F. Install flush valves at the low end of each drip zone minimum of 2 valves are required for each valve. Refer to manufacturer details for installation instructions.

G. Install air vacuum relief valve(s) at high point(s) of each planting area. Refer to drawings for approximate locations. Revise locations in field based on actual grades of the site. Locate 1 valve per every 500’ of dripline. Refer to manufacturer details for installation instructions.

H. Thoroughly saturate soil prior to planting. Provide additional surface watering as required to keep plant root systems moist during planting establishment period.

3.14 FIELD QUALITY CONTROL

A. Coverage Tests:

a. Perform coverage tests in the presence of Project Representative, after sprinkler or drip system is completed. Test system to assure that all areas are irrigated completely and uniformly.
b. Do not spray onto pavement or structures. Adjust arc nozzles as needed to provide full coverage without over spray.

B. Adjusting and Cleaning:
1. System adjustment:
a. Valves: Adjust flow for proper operation.
b. Heads: Adjust for alignment and coverage.
c. If it is determined that coverage could be improved by adding additional driplines or a nozzle change, make such changes as required to provide adequate coverage to all plant material.
d. Perform final cleaning of all risers, dripline, heads, and equipment for proper operation. Demonstrate operation and uniform coverage in the presence of the Project Representative prior before final acceptance.

3.15 TESTING

A. General
a. Notify the Project Representative at least three (3) days in advance of testing.
b. Furnish all necessary testing equipment and personnel.
c. Perform testing at his/hers own expense.
d. Correct all leaks and retest until acceptance by the Project Representative.
e. Center load piping with small amount of backfill to prevent arching or slipping under pressure. No fitting shall be covered

B. Closing uninspected work: Do not allow or cause any of the work of this section to be covered up or enclosed until it has been inspected, tested and approved by the Project Representative and other authorized agencies.

C. Flushing: Before backfilling the main line, and with all control valves in place but before lateral pipes are connected, completely flush and test the main line and repair all leaks. Flush out each section of lateral pipe before sprinkler heads are attached.

D. Perform test as specified below. Remake any faulty joints with all new materials. Use of cement or caulking to seal leaks is absolutely prohibited.

E. Pressure Testing Procedure:
a. Apply the following tests after welded plastic pipe joints have cured at least twenty-four (24) hours.
1) Solvent Weld Mainline: Remove all the air from the piping system then test live (constant pressure) and QCV lines hydrostatically at 125 PSI minimum. Lines will be approved if test pressure is maintained for six (6) hours. The lines shall be restored to the original test pressure. The Contractor shall make tests and repairs as necessary until test conditions are met.
2) Test RCV controlled lateral lines with water at line pressure and visually inspect for leaks. Retest after correcting defects.

F. Final Inspection
a. Thoroughly clean, adjust and balance all systems.
b. Demonstrate the entire system to the Irrigation Consultant and/or, if required, authorized agent and other governing agencies providing that all remote control valves are properly balanced, that all heads are properly adjusted for radius and arc of coverage, and that the installed system is workable, clean and sufficient.

3.16 GUARANTEE

A. It shall be the responsibility of the Contractor to fill and repair all depressions and replace all necessary lawn and planting due to the settlement of irrigation trenches for one year following completion and acceptance of the job.

B. The Contractor shall also guarantee all materials, equipment and workmanship furnished by him to be free of all defects of workmanship and materials, and shall agree to replace at his expense, at any time within one year after installation is accepted, any and all defective parts that may be found.

3.17 MAINTENANCE

A. Continuously maintain irrigation system in areas indicated in the Contract during the progress of work and for a period of 90 days after substantial completion.

B. It is Contractor's responsibility to turn over the irrigation in a first-class condition at the end of the maintenance period.

C. Maintenance Schedule: Contractor shall submit schedule of maintenance tasks to be performed for Project Representative review and approval. At a minimum, maintenance staff shall be on-site two times per month. It is not the intention of these Specifications to allow a "quick cleanup" at the end of the maintenance period, but rather that the work be continuous and ongoing.

D. Proper irrigation system maintenance includes the overall supervision of the system, controller scheduling, routine adjustments and necessary repairs.

E. Maintain irrigation system for optimum performance, as per manufacturer’s specifications, by inspecting the entire system on an on-going basis. This includes cleaning and adjusting all bubbler heads, dripline and valves for proper coverage.

3.18 CLEAN-UP

A. Preservation and Cleaning: The Contractor shall clean up the work as it progresses. At frequent intervals, and at all times when directed by the Project Representative, the Contractor shall remove and dispose of accumulations of rubbish and debris of all kinds. At the time of completion, the entire site shall be cleared of tools, equipment, rubbish, etc., all of which shall be removed from the site; and the entire project, including surrounding premises, shall be left in proper, clean condition ready for acceptance.

END OF SECTION

SECTION 329119
LANDSCAPE GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Weeding.

B. Finish grading for lawns

C. Finish grading for planting areas.

1.02 RELATED REQUIREMENTS

A. Division 31 Section Site Clearing

B. Division 31 Section Grading

C. Division 32 Section Decomposed Granite Surfacing

D. Division 32 Section: Landscape Work

1.03 DEFINITIONS

A. Finish Grading: finish grading shall consist of adjusting and finishing soil surfaces with site or imported topsoil, raking grades to a smooth, even, uniform plane. Remove and legally dispose of all extraneous matter off site. Facilitate natural run-off water and establish grades and drainage indicated as part of the contract work.

B. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

C. Finish Grading: Finish grading shall consist of finishing surfaces by raking smoothly and evenly to facilitate natural run-off water, and by removing and disposing of extraneous matter.

D. Sub-grade: The surfaces upon which additional specified materials are to be placed, prepared, or constructed.

E. Rough Grade: The establishment of grades to required tolerances.

F. Finish Grade: Spot elevations (grades) are indicated based on the best available data. Contract Civil Drawings are referenced to provide additional site grading information. It is intended that constant slopes are maintained between spot elevations.

G. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.04 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 EXISTING UTILITIES

A. Stake and mark the location of existing utilities before commencing work.

B. Retain and protect in operating condition all active utilities traversing the site designated to remain.

1.06 QUALITY ASSURANCE

A. Finish grade shall conform to contours, grades, lines, and shapes, as indicated on Contract Drawings, with uniform slopes between finish grades or between finish grades and existing grades.

B. Establish finish landscape grades in a continuous, uniform line, resulting in a uniform surface with no ridges or water pockets.

C. Finish landscape grade tolerance shall be 0.04-feet plus-or-minus from finish elevations indicated on site drawings.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS:

A. Topsoil: A natural, fertile, friable soil, free from stones, roots, clods larger than 1" in diameter, noxious seeds, weeds, subsoil, undesirable insects, plant disease or any other natural objects detrimental to normal plant growth.
   1. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing 2.0-millimeter sieve.
   2. Total pore space content on a volume/volume basis shall be at least 15 percent at field capacity.
   3. Permeability rate shall be not less than one inch per hour or more than 20 inches per hour.
   4. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECE) shall not exceed 2.0 milliohms per centimeter at 25 degrees centigrade.
   5. Soluble boron shall be no greater than 1.0 part per million (mg/l).
   6. Soil pH range shall be 6.0 - 7.9.
   7. Maximum concentration of soluble chloride shall be 150 parts per million.
   8. Maximum concentration of heavy metals shall not exceed the following when the pH is between 6 and 7:
      a. Arsenic: 1 ppm
      b. Cadmium: 1 ppm
      c. Chromium: 5 ppm
      d. Cobalt: 1 ppm
      e. Lead: 15 ppm
      f. Mercury: 0.5 ppm
      g. Nickel: 2.5 ppm
      h. Selenium: 1.5 ppm
      i. Silver: 0.25 ppm
      j. Vanadium: 1.5 ppm
   9. Petroleum hydrocarbons shall not exceed 100 mg/kg dry soil.
   10. Aromatic volatile organic hydrocarbons shall not exceed 2 mg/kg dry soil.

B. Obtain imported topsoil from approved local sources.

C. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of Section 329300.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verification of conditions: Prior to commencing the finish grading, review the installed work of other trades and verify that their work is complete.
   1. Rough Grading: Grading in planting areas (except raised planter areas) shall be established to within plus or minus 0.10 foot prior to beginning of finish grading.

B. Import topsoil only when necessary to supplement site soil to achieve grades shown on Drawings, or if site soil is unsuitable for planting.

3.02 PREPARATION:

A. Weeding: Before finish grading, weeds and grasses shall be dug out by the root or sprayed with an herbicide and disposed of off-site. This procedure is outlined in Section 329300-Landscape Work.

B. Remove debris, roots, branches, weeds, stones, in excess of 1/2-inch (13 mm) in size and clumps of earth that do not break up. Before and during finish grading, remove weeds and grasses, including roots, and dispose off-site.

C. Remove soil contaminated with petroleum products and legally dispose off-site.

3.03 INSTALLATION:

A. General: When rough grading and weeding have been completed, and the soil has dried sufficiently to be readily worked, lawn and planting areas shall be graded to the elevations indicated on the Drawings.
   1. Grades indicated on Drawing are grades that will result after thorough settlement and compaction of the soil.
   2. Grades not otherwise indicated shall be uniform finish grades and, if required, shall be made at the direction of the Architect.
   3. Finish grades shall be smooth, even, and a uniform plane with no abrupt change of surfaces.
   4. Soil areas adjacent to buildings shall slope away from the building to allow a natural run-off of water, and surface drainage shall be directed as indicated on the drawings by remodeling surfaces to facilitate the runoff water at 2% minimum grade.
   5. Low spots and pockets shall be graded to drain properly.

B. Drainage: Finish grade with proper slope to drains.
   1. Flow lines, designated or not, shall be graded and maintained to allow free flow of surface water.
   2. If any drainage problems arise during construction period due to Contractor's work (such as, but not limited to, low spots, slides, gullies and general erosion), the Contractor shall be responsible for repairing these areas to a condition equal to their original condition, and in so doing shall prevent further drainage problems from occurring.

C. Prior to placing backfill, remove rock, aggregate base, concrete, and deleterious materials to a depth of 18 inches below soil grade in planter areas. Cross-rip subsoil of friable soil to a depth of 12-inches.
   1. Place a minimum of [15-inches] of topsoil backfill in planters.
   2. Refer to Section 329300 “Landscape Work” for soil materials.

D. Toe of slope: To prevent soil creep or erosion across pavement, where pavement (walk, curb, etc.) is at the toe of a slope, finish grade is to level out or swale slightly at least 12-inches before reaching pavement.

E. Moisture Content: The soil shall not be worked when the moisture content is so great that excessive compaction occurs, nor when it is so dry that dust may form in the air or that clods do not break readily. Water may be applied, if necessary, to provide moisture content for tilling and planting operations. It is the Contractor's responsibility to control dust that is spread as a result of grading operations.

F. Grades: The finish grade in areas to be planted with turf shall be 1-inch below grade of adjacent pavement, walks, curbs, or headers. Finish grade in shrub areas shall be 2 1/2-inches below adjacent surfaces. Exceptions may be made when drainage conditions require flush grades, as directed by the Architect.

G. Compaction: Soils in planted areas shall be loose and friable, yet firm enough that no settling occurs from normal foot traffic or irrigation.

3.04 FIELD OBSERVATION:

A. It is the Contractor's responsibility to contact the Architect 48 hours or two working days in advance of each agreed observation or conference.

B. Schedule for On-Site Reviews: at completion of finish grading and prior to any planting operations.
   1. See "Site Observation" in Part 3 of Section 329300-Landscape Work to coordinate inspections and review of work.

END OF SECTION

SECTION 329300
LANDSCAPE WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Soil Prep and Fertilization.
B. Planting Operation.
C. Planting Materials.
D. Topsoil and Planter Mix.
E. Agronomic Testing.
F. Drainage Materials.
G. Jute Mesh and Erosion Control.
H. Mulching.
I. Sod
J. Pruning
K. Tree stabilization.
L. Edgings.
M. Root Barriers.

1.02 RELATED REQUIREMENTS

A. Division 01 Temporary Tree and Plant Protection
B. Division 12 Section Site Furnishings.
C. Division 31 Section Site Clearing
D. Division 32 Section Landscape Grading
E. Division 32 Section Landscape Irrigation
F. Division 32 Section Landscape Maintenance
G. Division 33 Section Storm Drainage Utilities

1.03 REFERENCE STANDARDS

A. American Association of Nurserymen, Inc. (AAN)
    1. American Standard for Nursery Stock, latest edition (ANSI).

1.04 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.

D. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.

E. Bio-filtration Planting Soil: Imported specialty Soil manufactured offsite by XXXXX required for storm water infiltration.

F. Root Zone: Imported specialty soil manufactured offsite by XXXXXX to be placed beneath turf fields.

G. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.

H. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.

I. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.

J. Finish Grade: Elevation of finished surface of planting soil.

K. Sub-grade Elevations: Excavation, filling and grading required to establish elevations is shown on drawings. Coordinate all work with grading contractor in order to arrive at rough grades that will allow tolerance for topsoil in planting areas, soil amendments and ornamental mulch as required in other sections of this specification. Contractor to assume tolerance of rough grades established at ± 0.09 feet (less than 1 tenths of a foot)

L. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

M. "Diameter at breast height" (DBH) is measurement for tree trunk caliper.

N. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.

O. Planting Soil: Native or imported topsoil; mixed with soil amendments.

P. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

Q. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

R. Pruning: As designated on contract drawings. Items not specifically indicated or specified, but normally required to conform with such work, are considered part of the work.

1.05 SUBMITTALS

A. WITHIN 30 DAYS OF START OF THE ROUGH GRADING OPERATIONS:
   1. Submit a certificate indicating all plant material has been secured for the project and is available.
   2. Submit documentation that all plant material has been ordered in accordance with Article 1.06 of this section.

B. CERTIFICATION: Submit the following:

1. Certificates of inspection as required by governmental authorities when transporting materials into the state.
2. Bulk Materials: Submit a certificate of delivery for all material in containers or bulk.

C. TEST REPORTS: Submit the following:
1. Agronomic Soils Laboratory Test Report(s) including required amendments and maintenance recommendations.

D. PRODUCT DATA: Submit the following:
1. In accordance with Division 1 Section "Submittal Procedures", submit complete manufacturer descriptive literature and specifications for proprietary materials and any additional items required by the Architect. Prior to start of construction and submittals; furnish to the Architect the list of items to be submitted and reviewed.
   a. Soil Amendments (as identified in Agronomic Soils Report).
   b. Fertilizer (as identified in Agronomic Soils Report).
   c. Plant Tablets.
   d. Stakes and Guys.
   e. Tree Ties and Vine Ties.
   f. Seed Mixtures.
   g. Mulch.
   h. Edging Material.
   i. Filter Fabric.
   j. Drainage Materials.
   k. Accessory Material.(Root barriers, Tree Grates, Metal edging, Boulders, etc.)
   l. Other soil additives per Agronomic Soils Report.
   m. Rock mulch.
   n. Submit other data substantiating that materials comply with specified requirements. Such certificates may be tags, labels, and/or manufacturers literature. All submittals shall be reviewed and accepted by the Architect before contractor begins work.
   o. Substitution Request
      1) If any plant specified is not obtainable, submit a written substitution request to the Architect during the bidding period.
      2) Substitutions of plant material will not be permitted unless accepted in advance in accordance with the provisions of Division 1 Section "Product Requirements."
      3) The Contractor is responsible for contract growing all required plant material for to project to ensure availability in the size and requirements of the project.
      4) All substitution requests for any material must be made during the bid process. No substitution requests will be permitted after the bid process or during.
   p. With submittal of Bid Documents, submit complete list of plant materials to be provided, including unit prices for plants and for installation. Include:
      1) Quantity.
      2) Size.
      3) Botanical Name.
      4) Plant Unit Price.
      5) Installation Unit Price.
2. PLANTING SCHEDULE: Submit proposed planting schedule at least two months prior to planting any materials, indicating dates for each type of landscape work coinciding with normal seasons for such work. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. If dates need to be revised after acceptance of planting schedule, document reasons for delays and submit for acceptance.

3. Submit two photos of each tree(include DBH, height and spread), shrub(include height and width) and groundcover(include height and width) with a person in the image to be used on the project to the architect for review. Photos are to be of the actual material tagged, or secured and that will used for the project at the sourced nursery. No plants may be delivered or planted prior to approval by Architect.

1.06 QUALITY ASSURANCE

A. QUALIFICATIONS

1. Nursery Qualifications: Regularly engaged, for the preceding ten years, in the production of planting materials equivalent in species and size to those required.
   a. Stocked, and having a demonstrated ability to provide plant materials required within the constraints of the accepted construction schedule.
   b. Landscaper's Qualifications: Regularly engaged and specializing, for the preceding ten years, in the installation and maintenance of planting materials equivalent in species and size to those required.
      1) Capable of furnishing a verifiable list of not less than five projects of equivalent type successfully completed within the preceding two years.
      2) Subcontracts: Landscape work to a single firm specializing in landscape installation.
2. Pre-Installation Conference: Schedule in advance of beginning work of this section. Arrange for attendance by Owner, Architect, and landscaping subcontractor. Review intent of Contract Documents and resolve conflicts. Prepare minutes of conference and distribute to attendees within five (5) days.
3. Source Quality Control
   a. General: Comply with regulations applicable to shipping of landscape materials.
   b. Analysis and Standards: All materials shall be of standard, approved and first-grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged material shall be delivered to the site in the original unopened container bearing the manufacture's guaranteed analysis. The Contractor shall supply the Architect with a sample of all materials accompanied by analytical data from an approved laboratory source illustrating compliance of bearing the manufactures guaranteed analysis.
4. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
5. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
   a. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
6. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
   a. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than 4"; do not obtain from bogs or marshes. All topsoil is to be tested and analyzed by an independent laboratory before delivery to site, as indicated in Article 3.03.

7. Contractor shall provide the Architect with location of soil, crops previously planted on such soil within the last two years, and the USGS soil survey classification and name.
8. Trees, Shrubs and Plants: Provide trees, shrubs and plants of quantity, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1-1980 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free from disease, insects, insect eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, overlapping surface roots, or disfigurement. Central leaders of all trees shall be intact, undamaged, with evenly spaced lateral branches.
    a. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
9. Label all trees and shrubs with securely attached waterproof tag bearing legible designation of botanical and common name. Where formal arrangements and consecutive order of trees is shown, select stock for uniform height/spread, and label with number to assure symmetry in planting.
10. Stock Review: The Architect will review trees and shrubs at site before planting with requirements for genus, species, variety, size and quality. The Architect retains right to further review trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of the work. Remove rejected vegetation immediately from project site. Contractor shall request review of such stock by the Architect by delivering notice, in writing, 72 hours in advance.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver exterior plants freshly dug.

B. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

C. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
    1. Protect plants from sun or drying winds. Protect and maintain plants that cannot be planted immediately upon delivery.
    2. Do not drop plant material.
    3. Do not pick up container planter material by stems or trunks.
    4. Protect from wind.
    5. Water as required.
    6. Do not prune trees and shrubs before delivery except as approved by Architect. Do not bend or bind trees or shrubs in such manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery, and provide protection on site from traffic, pedestrians, and deleterious effects of climate while planting operations are in progress. Dropped or damaged stock will not be accepted.
    7. Deliver trees and shrubs after preparations for planting have been completed and plant immediately after approval of plant materials locations. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture. Do not remove container grown stock from containers until planting time.

a. Do not pick up plants by stems or truck. Handle planting stock by root ball.
b. Do not remove container - Grown stock from containers before time of planting.
c. Water root systems of exterior plants stored onsite with a fine-mist spray.
d. Water as often as necessary to maintain root systems in a moist condition.

8. Plant material shall not be stored on the jobsite for more than 48 hours before planting. Contractor shall schedule nursery deliveries in sub-groups as necessary to comply with this requirement.
9. Deliver accessory materials in manufacturer's original, unopened packaging with identifying labels affixed and legible in accordance with state law. Deliver plants with identifying tags affixed. Contractor shall notify Architect 72 hours in advance of plant material delivery for observation. Review plants with Landscape Architect to confirm that they are the plants which had previously been tagged and supplied. The Architect reserves the right to reject the following:
   a. Plant materials not identifiable as previously selected.
   b. Materials not accompanied by required certificates.
   c. Plant materials where damage to rootball, trunks, or desiccation of leaves has been caused by inadequate protection during delivery.
   d. Plant material not matching the form, shape, or growth habit required for the design intent of the Project.
   e. Horticultural or visual defects in material.
   f. Plant material pruned prior to delivery.
   g. Plant material with detrimental pests.

1.08 PROJECT CONDITIONS

A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
   1. Planting Restrictions: Coordinate planting periods with maintenance periods to provide required maintenance from date of substantial completion.
      a. Plant or install materials during normal planting seasons for each type of landscape work required.
   2. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed without having detrimental effects on the plant material, or finished product.
   3. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Architect.
      a. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.
   4. Contractor shall verify locations of all existing utilities, whether shown on plans or not. The Contractor shall notify members of Underground Service Alert (DigAlert) two (2) working days in advance of performing any excavation work by calling the toll-free number 1-800-227-2600 or 811.
   5. After determining location of underground utilities, perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
   6. When conditions detrimental to plant growth are encountered, such as rubble fill, hardpan condition, adverse drainage conditions, or obstructions, notify the Architect before planting. Remove all material deemed unsuitable for plant growth as directed by the Architect.
   7. No landscape materials may be planted before an irrigation operation and coverage test is completed by the Architect.
   8. No landscape materials may be planted before finish grade is reviewed by the Architect.
   9. Existing Trees:

a. Prior to the beginning of any clearing, grubbing, trenching, or excavation on site, the general contractor, grading contractor, project arborist, landscape contractor, and the Architect shall meet in a pre-construction conference to discuss grading near existing trees.
b. The contractor shall protect all existing trees and shrubs scheduled to remain against injury or damage, including cutting, breaking or skinning of roots, trunks or branches. No blasting of rock shall occur in any area adjacent to existing trees without prior written consent of the Architect.
c. No trees or shrubs are to be removed, trimmed, or cut without prior approval of the Architect.
d. Prior to the beginning of the clearing and grading phase of the project, a continuous, temporary, six foot (6') high chain link fence shall be erected around the drip line of all trees scheduled to remain, unless otherwise specified by the Architect. The temporary fencing shall be erected prior to commencing any other work on the project. No construction activity shall be allowed within the limits of this fencing unless directed by the Architect. The temporary fencing shall remain in place during the entire construction period and shall not be removed until directed by the Architect.
e. Grading beneath trees to be saved shall be given special attention. Every effort shall be made to avoid creating conditions adverse to the tree’s health. The natural ground within the drip lines of trees to be preserved shall remain as undisturbed as possible. Grading within the protected root zone of trees to be preserved will not be permitted unless specifically approved by the Architect prior to beginning of proposed grading.
f. If during construction or grading (grading, excavation, etc.) tree roots of 2" in diameter or greater are encountered, work shall stop immediately and a Certified Arborist, approved in advance by the Architect, shall be contracted for a root inspection. Root cutting of any roots over 2" in diameter must have prior approval from the Architect. All cuts are to be made with appropriate equipment, as to not affect the plant material.
g. Major roots one inch (1") or greater in diameter encountered within the drip line of the tree in the course of excavation or trenching shall not be cut and shall be kept moist and covered with earth as soon as possible. Shredding of roots or damaged caused by trenching or grading equipment is not permitted.
h. Roots one half inch (1/2") to one inch (1") in diameter which are severed shall be trimmed cleanly and covered with earth as soon as possible.
i. All trenching beneath the drip line of trees to remain shall be done with hand tools only. No mechanical trenching or excavation is allowed within the drip line of existing trees at any time, or where roots are encountered outside the dripline of the tree.
j. Branches interfering with construction but not designated for removal may be removed only as directed by the Architect.
k. Any pruning, cutting, or trimming of any trees will be performed by an International Society of Arboriculture Certified Arborist or certified tree worker or in accordance with the National Arborist Association and/or International Society of Arboriculture pruning standards. Cutting of 2" diameter limbs or greater or major dead wooding shall require approval of the Architect.
l. Trees or shrubs scheduled to remain and damaged by construction operations shall be repaired by the contractor in a manner acceptable to the Architect. Damaged trees and shrubs shall be repaired promptly to prevent progressive deterioration. Repair or replacement of trees and shrubs shall be at the contractor’s expense as determined by the Architect. Contractor shall be held fully liable for damage caused to trees and shall be assessed fees based on the International Society of Arboriculture “Guide for Plant Appraisal”, as determined by the project Arborist; fees will be assessed for: 1) any injury to the trunk, limbs, or root system, and (2) for the value of any tree requiring removal subsequent to injury or treatment that varies from these Specifications.

m. A permit from the City Arborist may be required prior to pruning or removing any trees, as required by applicable codes or ordinances.
n. Parking of vehicles, equipment or storage of materials under the drip line of existing trees shall not occur at any time.
o. Wash all existing and new trees weekly to remove dust and debris during construction.

1.09 SCHEDULING

A. Within 30 days after the commencement of initial grading, furnish documentation to the Architect that all plant material has been secured for the project and is available. Contractor shall be responsible for payments and deposits required by the grower or plant consultant to secure, maintain, and grow plant material indicated on the Contract Drawings.

1.10 WARRANTY

A. Special Warranty: Warrant all plant material in writing where installer agrees to repair or replace plantings and accessories that fail in materials, workmanship or growth within specified warranty period.
1. Failures include, but not limited to, the following:
a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by owner.
b. Structural failures including plantings falling or blowing over including during high wind events.
c. Faulty operation of tree stabilization edgings tree grates.
d. Deterioration of metals, metal finishes and other materials beyond normal weathering.
e. Material not thriving.
f. Warranty periods begin from date of final completion:
1) Trees, vines, shrubs: One year.
2) Ground cover and turf: One year.
2. Warrant plant material, installed, or relocated under the contract, in writing, for a period of one year (after beginning of maintenance period) against defects including death, and unsatisfactory growth, except for defects resulting from neglect, abuse or damage by others.
3. Remove and replace trees, shrubs or other plants found to be dead, yellowing, defoliating, or in unhealthy condition, or other defective materials during warranty period at no additional cost to the Owner. Replace trees and shrubs, which in the opinion of the Architect, are in unhealthy condition at end of warranty period. The Architect shall be the sole judge as to the condition of the material. All replacement materials and installation shall comply with the drawings and specifications. Another inspection may be conducted at end of warranty period to determine acceptance or rejection.
4. Upon receipt of written notice from Owner of the loss of any warranted plant materials during the warranty period, the subject plant materials shall be promptly replaced with the same species originally planted, and of a size closely approximating the size of the plant, if normal growth had occurred since the original planting. Replacements shall be subject to the requirements of this specification.
5. When plants are replaced, advise the Owner, in writing, of the new establishment maintenance period equal to the one year.
6. Plant material must be replaced within ten (10) days of written notification, and shall be installed in accordance with these specifications.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Design is based on the use of products manufactured by the following.

B. California (Northern)
   1. Best Fertilizer Company, Lathrop, CA
   2. BFI Organics, Milpitas, CA 408-262-1401
   3. Deep Root Corporation, Burlington, CA 800-458-7668.
   4. Delta Bluegrass Co. Stockton, CA (209) 469-7979
   5. Horizon, Roseville, CA 916-780-2033.
   6. MacLean Civil Products, Fort Mill, SC 800-925-5360.(check for local distributor)
   7. Landscape Forms, represented by
      a. Rebecca Casey, 800-430-6206 X1313. (San Francisco, East Bay)
      b. Verushka Doshi, 269-276-4424 (San Francisco, Silicon Valley, San Jose, Marin, Peninsula)
      c. Nathan Damratowski, 269-337-1247 (Sacramento, Davis, Roseville, Chico, Redding, Vacaville, Napa, Tahoe, Valley)
      d. Ellie Ickes, 269-337-1239 (Santa Rosa, Stockton, Fresno, Modesto)
   8. LH Voss, Dublin, CA 925-560-9920
   9. Mirafi, Inc. Charlotte, NC. 800-438-1855.
   10. NDS Drainage Products, 800-726-1998.
   11. Pacific Coast Seed. 533 Hawthorne Place, Livermore, CA 94551 (925) 373-4417
   12. Pacific Sod, Patterson, CA, 800-542-7633.
   13. Redi-Grow Corporation, Sacramento, CA, 800-654-4358.
   14. S&S Seeds, Camarillo, CA 805-684-0436.
   15. Silverado Building Material, Sacramento, CA 916-361-7374.
   16. Soil and Plant Laboratory, Inc., Santa Clara, CA 408-727-0330.
   17. Sunland Analytical Labs, Rancho Cordova, CA 916-852-8557.
   18. TMT Enterprises, San Jose, CA 408-432-9040.
   19. Whitecap, Inc. Rancho Cordova, CA 916-636-3215.
   20. Best Fertilizer Co., Lathrop, CA.
   21. Wayside Lumber, Rancho Cordova, CA, 916-635-9090.
   22. Materials shall be the products of one manufacturer and shall be either the ones upon which the design is based, or the products of manufacturer accepted in advance. No substitutions will be permitted.

2.02 SOIL

A. TOPSOIL: Site to be rough graded to elevations shown on Civil Drawings. Topsoil will be required behind curb areas and in planting area. Provide on-site, import, or non-processed topsoil in planting areas as needed to complete rough grading which is fertile, friable, and natural loam in accordance with Article 2.03. Topsoil shall be from agricultural sources, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 3/4-inch in any dimension, and other extraneous or toxic matter harmful to plant growth.

B. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of this Section.

C. Biofiltration Planter Soil
   1. Pre-manufactured soil as purchased by Gail Materials.

a. The soil shall be a blend of 4 parts by volume washed sport sand to 1 part sandy loam topsoil. The gravel content shall not exceed 15% by weight with the largest allowable particle not exceeding 1/4 inch.
b. Chemistry:
    1) The pH shall be in the range of 6-8.0.
    2) Salinity shall not exceed 3.0 dS/m.
    3) Sodium: Sodium absorption ratio (SAR) shall not exceed 5.0
    4) Boron shall not exceed 1 ppm.
c. Amendments:
    1) The top 6 inch layer the following shall be uniformly blended by means of a pub mill or equal.
        (a) Amount/cubic yard
            (1) 10% by volume of Reed Sedge Peat Moss
            (2) 25% 8X20 Lassenite Pozzolan
            (3) 15 lbs. 6-20-20 fertilizer
            (4) 50 lbs. Gypsum
    2) For the depth below 6 inches uniformly blend by means of a pug mill or equal
        (a) Amount/cubic yard
            (1) 10% by volume AXIS medium grade.
d. Location(s)
    1) Use in designated infiltration planter areas and bioswale areas, see planting plans.
    2) Depth shall be per details.
    3) Available through Gail Materials, Corona, CA (951) 667-6106
    4) Contact: Dave Dzwilewski

2.03 SOIL AMENDMENTS

A. The initial application of fertilizers and amendments to be tilled into the soil during soil preparation operations shall be established after soil testing has been conducted by Contractor. An estimated quantity is indicated below for bid purposes only. This estimated quantity does not include mulching, fertilizer tablets, additional topsoil necessary to meet specified grades and fertilizer applications for after planting. After soils analysis recommendations are made to the Architect quantifying the actual amount of amendments required and recommendations have been accepted by the Architect, the Contractor shall, without delay, determine any cost impacts whether credit, no change, or addition, to the Contract Amount. As an integral part of the bid for Landscape Work, provide a Lump Sum bid amount for fertilizers and amendments as described below.

B. Application Rates (FOR BID PURPOSES ONLY):
    1. Sixty (60) lbs. of Tri-C Humate per 1,000 square feet.
    2. Nineteen (19) lbs. of 6-20-20 fertilizer per 1,000 square feet.
    3. Six (6) cubic yards of Aguiñaga GPS2, nitrogen stabilized compost per 1,000 square feet.
    4. 50-lbs Agricultural Gypsum, per 1,000 square feet.

C. Pot or Raised Planter Soil Mix: Prepare and backfill pots with a mix of the following per cubic yard:
    1. Jardinier Capillary Soil
    2. 12-12-12 Commercial Fertilizer
    3. Organic Amendment - 1/3 cubic yard
    4. Fine Sand - 1/3 cubic yard
    5. 12-12-12 Commercial Fertilizer - 1 pound
    6. Iron Sulfate - 2 pounds

D. Actual amendment rates and type shall be per soil test recommendations.

E. Imported Topsoil
   1. Provide natural, fertile, friable soil free from stones, noxious weeds, seeds, roots, subsoil or other material detrimental to normal plant growth. Topsoil acidity range (pH) shall be between 6.5 and 7.5 containing a minimum of 4 percent and a maximum of 25 percent organic matter.
   2. Reuse surface soil stockpiled onsite. Verify suitability of stockpiled surface soil to produce top soil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
      a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain top soil displaced from naturally well drained sites where topsoil occurs at least 4 inches deep; do not obtain from [agricultural land], bogs or marshes. Obtain soil from local sources acceptable to the Architect.
      b. Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2 millimeter sieve.
   3. Obtain imported topsoil from local sources acceptable to the Architect.
   4. Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2-millimeter sieve.

F. Organic soil amendment:
   1. "Nitrified Redwood Compost": 0.56 to 0.84% N based on dry weight, treated with relative form of nitrogen (NH3).
      a. Particle Size
      b. 95% - 100% passing 6.35 mm standard sieve.
      c. 80% - 100% passing 2.33mm standard sieve.
      d. Salinity: The saturation extract conductivity shall not exceed 3.5 millimhos/centimeter at 25 degrees (25N) centigrade as determined by saturation extract method.
      e. Iron Content: Minimum 0.08% dilute acid soluble Fe on dry weight basis.
      f. Ash: 0 - 6.0% (dry weight)
      g. Acidity range (ph) shall be between 5.5 and 7.5.
      h. Actual organic content shall be a minimum 280 pounds (lbs.) per cubic yard.
      i. As available from: Redi-Grow Corporation, 909 Elder Creek Road, Sacramento, CA 95828
   2. Organic soil amendment shall be Aguinaga GPS2.
   3. Particle Size:
      a. 90-100 percent passing 6.35 mm standard sieve.
      b. 80-100 percent passing 4.75 mm standard sieve.
   4. Salinity: The saturation extract conductivity shall not exceed 6.5 milliohms/centimeter at 25 degrees Centigrade as determined by saturation extract method.
   5. Iron Content: Minimum 0.08 percent dilute acid soluble iron on dry weight basis.
   6. Actual organic content shall be a minimum of 280 pounds (lbs.) per cubic yard.

G. Fertilizers
   1. Tri-C Humate. Provide per manufacturers specification.
   2. Fertilizer Tablets: Fertilizer Tablets: The following is to be used in the planting of container grown material. Follow manufacturer's application rates.
      a. Best-Paks "20-10-5" fertilizer packets. Packets to be made up of a minimum of 20% Nitrogen, 10% Phosphorus, 5% Potash. Use 1 Pak per 1-gallon container, (G.C.), 3 Paks per 5 G.C., 9 Paks per 15 G.C. and 12 Paks per boxed specimen. Evenly distribute as shown in details.
   3. Commercial Fertilizer: First Quality Commercial Fertilizer, as specified in Agronomic Soils Report.

H. Related Materials:

1. Pre-Planting Herbicide: Phydura, or equal.
2. Pre-Emergent Weed Control: Ronstar-G, Treflan, Eptam, Vegitex, or equal.
3. Peat Moss: Sphagnum peat moss, Canadian or European variety, free from alkali.
4. Soil Sulfur: First quality commercial grade.
5. Ferrous Iron Sulfate: Chelated first quality commercial grade.
6. Agricultural Gypsum: First quality commercial grade.
7. Best "Ammonium Phosphate" 16-20-0 with net less than 16% total nitrogen, 20% available phosphoric acid and 0% soluble potash.
8. Good Humus.
9. Root Hormone: Super Thrive.

2.04 PLANT MATERIALS

A. Quality: Provide trees, shrubs, and other plants of size, form, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".

B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
   1. Lateral scaffolds shall be radially distributed around the trunk. The lateral branch shall be no more than 2/3 the diameter of the trunk. Trunk to be measured 1" above the branch (lateral scaffold).
   2. The minimum acceptable length of the most recent season's shoot growth for slow growing trees shall be not less than 8"; for fast growing trees not less than 12".
   3. The minimum acceptable height of trees is 6'-0" when planted, or as determined by Architect.

C. Needle Leafed and Broad Leafed Evergreen Trees: Provide evergreens of sizes shown or listed. Where dimensions are shown, they indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.
   1. The minimum acceptable height of trees is 6'-0" when planted, or as determined by Architect.

D. Multi-Trunk Trees: Provide sizes shown or listed. Tree is to have a minimum of three (3) dominant trunks with appropriate caliper size and adequate spread.
   1. Shrubs: Provide shrubs of the size shown and with not less than the minimum number of canes required by ANSI Z60.1 for type of shrub required. Provide container grown stock.

E. Ground Cover: Provide plants established and well-rooted in removable containers, in flats, or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the size shown or listed.

F. Vines: Provide vines with good, well-established root systems within the container, and devoid of any abrasions, and or damage to stem.

2.05 SOD

A. Lawn Sod:
   1. Nursery-grown sod shall have the following characteristics:
      a. Sod for planting areas shall be dense, healthy, field-grown on sand fumigated soil with the grass having been mowed at 1-inch height before lifting from field.
      b. Sod for grass pave areas shall be dense and healthy, grown on a sand bed thin cut and washed.

c. Sod shall be dark green in color, relatively free of thatch, free from disease, weeds and harmful insects.
d. Sod shall be reasonably free of objectionable grassy and broadleaf weeds. Sod shall be considered weed free if no more than 2 such weeds are found per 100 square feet of sod.
e. Sod shall be rejected if found to contain the following weeds: common Bermuda grass, quack grass, Johnson grass, nimble weed, thistle, bindweed, bentgrass, perennial sorrel, and bromegrass.
f. Sod variety shall be:
    1) Turf Grass: Tiffway II, Bullseye, Bandera, GN1, Medallion Plus 90% Tall Fescue/10% Bluegrass Blend, as produced by West Coast Turf / Pacific Sod.
    2) Molate Fescue: No Mow Fine Fescue Blend, as produced by Pacific Sod.

2.06 MISCELLANEOUS LANDSCAPE MATERIALS:

A. Tree Stakes: Provide stakes of sound new lodgepole pine 2 inch minimum diameter for 15 gallon to 24 inch box size trees; 3 inch minimum diameter for 36 inch box and larger. Lodge pole minimum height, as indicated on Contract Drawings. Stakes shall have been treated with copper napthanate or ACQ (alkaline) or Ca-B (copper azole) to a minimum wood depth of 1/16". All stakes shall be free of knots larger then 1/2" in diameter, holes and other defects.

B. Tree Straps: Provide VIT black tree straps. Tree straps shall be attached to tree stake as shown in staking detail on the plans, color to be black.
    1. VIT "Cinch-Tie" CT32 for 24-inch box size and smaller tree.
    2. VIT "Twist Brace" TB36 for 36-inch box size and larger tree.

C. Vine Ties: Plastic vine ties, as specified on plans.

D. Headers and Edging
    1. Concrete edger: Dimension as specified on plans, poured in place concrete edger, color per plan.
    2. Wood Edging:
        a. Rough construction heart redwood, 12-foot minimum length, free from knots and splits. Provide 2 by 4 for straight sections and three laminations of ¼-inch material for curved sections.
        b. Stakes: 1 by 2 by 18-inch construction heart redwood, bevel cut.
        c. Scabs: 1 by 4 by 4-feet long construction heart redwood.
        d. Nails: Common, galvanized, 16d.
        e. Splices: 1 by 4 by minimum 24-inches long.

E. Mulch
    1. River Cobble Mulch: Washed River Cobble blend consisting of x-x diameter cobbles. Place xx inch minimum depth and extend xx inch either side beyond weed control fabric edge.
    2. Rock Mulch: As indicated on drawings. All xxxx-inch "xxxxx" aggregate rock mulch shall be washed twice by Contractor and shall be clean prior to installation.
    3. Bark Mulch:
        a. Mulch shall be shredded bark mulch, as manufactured by Whittier Fertilizer, Pico Rivera, CA.
            1) Mulch shall consist of shredded bark mulch with a particle range of 2-3/4-inch to 1-inch in size.
        b. Mulch shall be Walk-On Bark
            1) As available from Redi-Grow Corporation, Sacramento, CA.

4. Weed Control Fabric: Place Mirafi Mirascape landscape fabric below rock mulch or as shown on drawings. Overlap all seams 12" minimum and pin down every 36" typical. Mirascape fabric available from: Towns & Associates, 800-222-6036

F. Root Control Barriers: High-density polyproylene root control planter. Acceptable products include:
1. Deep Root; Deep Root Corporation.
2. Size as specified on drawings.

G. Drainage Materials
1. Gravel in raised planters on structural slab and in pots shall be clean, coarse 3/8-inch to 3/4-inch diameter.
2. Gravel for tree drainage shall be 3/4" diameter coarse clean gravel.
3. Synthetic filter membrane cover over drainage course shall be woven synthetic fabrics.
a. Model 140N, as manufactured by Mirafi.
4. Drain Pipe at trees: 4-inch diameter PVC perforated(within gravel), and non-perforated PVC drain pipe(stand pipe) with PVC adaptor connected to 4-inch ABS female reciever with 4-inch black ABS cleanout plug.

H. Sand: Washed plaster sand.

I. Jute Netting: A uniform open plan weave, single jute yarn not varying in thickness by more than 1/2 of its normal diameter, in rolled strips approximately 50 to 75 yards long and 50 to 60 inches wide. Contractor shall submit sample for approval prior to installation.

J. Staples: 11 gage with 1-inch top and 6-inch legs.

K. Sod Pegs: 1-inch square by 6-inch long pine or 6-inch lengths of lath.

L. Weed Control: Phydura, or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected, and Architect has reviewed and accepted materials as defined within the section.

3.02 SITE OBSERVATION SCHEDULE

A. General: Notify Landscape Architect at least 3 days in advance when requesting on-site reviews.

B. Prior to commencement of site visits, items noted in previous observation reports shall have been either completed or remedied, unless such compliance has been waived. Failure to complete prior tasks or failure to prepare adequately for scheduled observations shall obligate Contractor to reimburse Architect for additional hourly services, plus transportation costs

C. Schedule For On-Site Reviews by the Landscape Architect:
1. Pre-construction conference with general contractor, grading contractor, landscape contractor, project arborist and landscape architect to discuss grading and protective measures to be followed in the vicinity of existing trees, or existing structures.
2. At completion of finish grading, and roto-tilling
3. Review of irrigation coverage prior to installation of any planting material.
4. At completion of fine grading and at delivery of plant materials, together with plant layout; prior to excavating pits.

5. Review of drainage system, standpipes, and plant material locations.
6. After planting pits have been excavated, but prior to backfilling. Provide one sample plant pit mock up for review.
7. After initial planting operations (One tree with each type of specified staking shall be approved prior to planting of trees).
8. Stake all tree locations for review.
9. See "Final Review and Acceptance" at the end of Part 3 in this Section for final site observations and acceptance of work.

3.03 TESTING

A. Planting Soil: Agronomic Soil Testing
   1. Test shall be paid for by the Contractor. (NoCal) Testing lab shall be:
      a. Sunland Analytical Labs, Rancho Cordova, CA
      b. Waypoint Analytical, Santa Clara, CA
   2. Agronomic Soils Testing
      a. Take three(3) samples of site soil at a depth of 6 to 12 inches, within proposed planting areas, after completion of final grading and prior to weed control and soil preparation.
      b. Take samples to agronomic soils testing laboratory indicated above for soil evaluation.
      c. Request testing for fertility and suitability analysis with written recommendations for soil amendment, fertilizer and chemical conditioners, application rates for soil preparation, planting backfill mix, pot-soil mix, hydro-spray, and post-maintenance fertilization programs.
      d. Soils report recommendations shall take precedence over the amendment and fertilizer application rates specified in this section.
      e. Submit testing laboratory's interpretation, recommendations, and comments to Architect within 14 days after the completion of rough grading.
      f. Furnish a soils analysis of import soil, and organic soil amendment prior to backfill.
         1) Submit soil testing laboratory's findings to Architect within 5 days prior to backfilling.
      g. Take six additional soil samples after completion of planting in the soil preparation and backfill mix areas, to be determine effectiveness to amendments prior and during planting. Submit to the testing laboratory the original amendment specification with previously issued bulletins for soil amendments and installation procedures. Re-apply necessary amendments based on recommendation of new soils test.

3.04 PREPARATION

A. Final Grades
   1. Finished grading shall insure proper drainage of the site. Conform to Division 31 Section "Earthwork" and Division 32 Section "Landscape Grading."
   2. The following areas shall be graded so that the final grades shall be established below adjacent paved areas, sidewalks, valve boxes, headers, clean outs, drains, manholes, etc. before placement of mulch as follows:
      a. Shrub/Groundcover Areas: 2-1/2 inches.
      b. Turf areas: 1-inch.
      c. Surface drainage shall be away from all building foundations, 2% minimum.
      d. Dispose of excess or unacceptable soil from the site at no expense to the Owner.
      e. Verify that final grades have been established prior to beginning planting operations.
   3. Parking Lot Planters and areas adjacent to hardscape.

a. All aggregate base rock, lime-treated soil, soil sterilents, and other non-organic materials shall be removed from all parking lot planter areas down to the level of native soil. Scarify native soil to a depth of 12 inches and backfill planters to specified finish grade with native or approved topsoil and amend as specified.
b. Remove all concrete overpours or any material that may prohibit the placement of plant material, irrigation, grates, root barriers, or any other conflicting material.

4. Lightweight soil mix shall be sampled after mixing and delivery to the site, but prior to filling planters. Submit the original lightweight soil specification to the testing laboratory with previous bulletins for lightweight soil mix. Provide 1-quart of lightweight soil mix for every 65 cubic yards for organic and fertility analyses. Fertility analysis, recommendations and interpretations shall be furnished by the testing laboratory to ensure all specified amendments have been provided. Lightweight soil is to be used only in locations indicated on the Contract Drawings and as approved by the Architect.
5. Protect planting areas from compaction by foot, trucks and heavy equipment.

3.05 PLANTING BED ESTABLISHMENT

A. Preparation Of Planting Area
1. Cross-rip on-grade planting areas to a minimum depth of 12 inches minimum 2 perpendicular directions. Remove stones over ½ inch (13mm) in any dimension and sticks, roots, rubbish and other deleterious matter per Division 32 "Landscape Grading".
2. Where additional soil is needed, place the top 15” with topsoil. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
3. Leach soil prior to amending.
4. After approximate finished grades have been established and soil has been leached, soil shall be conditioned and fertilized in the following manner: Soil condition shall, at the rate specified in the approved soils test recommendations, be uniformly spread and cultivated thoroughly by means of mechanical tiller into the top (8) eight inches of soil.
5. Broadcast soil amendments uniformly over surface of the area to be treated. Roto-till the top (8) eight inches of planting areas to evenly distribute the amendments and conditioners into the soil.
6. Retest as required to verify leaching was successful. All soil areas shall be compacted and settled by application of irrigation to a minimum depth of six (6) inches prior to any plant materials being installed.
7. At time of planting, the top 12 inches of all areas to be planted shall be free of stones, stumps, or other deleterious matter one 1/2 inch in diameter or larger, and shall be free from all debris, or similar objects that would be a hindrance to planting and maintenance.
8. Weed Eradication:
a. Manually remove all existing vegetation in planting areas and dispose of it offsite.
b. Fertilize planting areas with urea 30-0-0 commercial fertilizer at the rate of 0.5 pounds per 1000 square feet.
c. Water planting areas thoroughly and continuously(by irrigation system, hand/hose, water truck, or other) for a period of 3 consecutive weeks, or until the weed seed have germinated. If accepted in advance by the Landscape Architect, employ a specific watering duration and frequency program designed to germinate residual weed seeds.
d. Discontinue watering process for 2 days. Then apply a non-selective broad spectrum systemic herbicide for perennial weeds.(2 applications minimum) The type of herbicide to be used shall be determined by a licensed pest control applicator. If annual weeds are present, use straight contact herbicide in accordance with pest control applicator's recommendations.
1) Do not use a pre-emergent herbicide.

e. Allow sufficient period of time to ensure that weeds are dead. Follow herbicide manufacturer's directions.
f. Water planting areas thoroughly and continuously (by irrigation system, hand/hose, water truck or other)for a period of 3 weeks. A shorter watering period may be permissible at the discretion of the Landscape Architect. Discontinue watering process for 1 day prior to the second application of the herbicide spraying.(2 applications minimum) Re-apply the spraying operation with straight contact weed killer in accordance with pest control adviser's recommendations.
    1) Do not use a pre-emergent herbicide.
    2) Avoid irrigation for a minimum of 4 days for effective final weed kill.
g. Clear desiccated weeds from the area.
h. Water Planting areas thoroughly and continuously for 3 consecutive days to saturate upper layers of soil prior to planting operations.
i. Allow planting area soil surface to dry out for I day only prior to the planting application. Exercise care to not allow the soil surface to be either super-saturated with water or bone dry prior to the planting installation. Ensure moderate residual moisture within the top 1/4 inch of the soil surface.
j. The hydraulic equipment used for pesticide applications shall consist of an ISO-gallon minimum capacity fiberglass tank with complete mechanical agitation. The pump capacity shall be 10 gallons per minute while operating at a pressure of 100 pounds. Per square inch.
k. Distribution lines shall be large enough to carry the volume of water necessary for even, chemical distribution. The spray nozzle must cover a IS-foot swath, with a minimum output of 5 gallons per minute at 80 pounds per square inch.

9. Pre-emergent Weed Control: Immediately after planting, apply pre-emergent weed control to planted areas which will not be seeded.
10. Excavation For Trees And Shrubs
    a. Excavate pits, beds, and trenches as shown in details on the drawings.

B. Preparation for Lawn Areas: Limit preparation to areas which will be planted promptly after preparation.
1. Prepare planting area as described in 3.05 A.
2. Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Establish smooth uniform surface. Limit fine grading to areas which can be planted immediately after grading.
3. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
4. Restore lawn areas to specified conditions if eroded or otherwise disturbed after fine grading and prior to planting.

3.06 BIOFILTRATION PLANTER SOIL

A. The Biofiltration planter soil shall be placed on the planter area and firmed to a depth of as shown on the drawings. Mix shall be moist when spread to discourage migration in to the subgrade and to assist forming.

B. Soil mix shall be separated from drainage courses with geotextile fabric equal to Mirafi 140N.

C. See Grading Plans for locations and depths and Planting plans for plant material.

3.07 JUTE MESH

A. Make check slots before the netting is rolled out. Dig a narrow trench across the slope perpendicular to the direction of the flow. Fold jute, the same length as the trench, and press together. Location of check slots shall be a maximum of 50 feet apart.

B. Installation: Roll netting parallel to slope contours. The netting shall completely cover all areas as indicated on Contract Drawings. Overlaps shall be ample and well stapled.
   1. Lay netting smoothly, and in continuous contact with the soil surface at all points.
   2. Install without stretching. Where one roll of netting ends and a second roll starts, the up slope piece shall be brought over the buried end of the second roll so that there is a 12-inch overlap. Where two or more widths of netting are applied, side by side, the overlap shall be not less than 3 inches.
   3. Staple overlapping edges that run parallel to the direction of the flow at 2-inch intervals. Outside edges, centers, and overlaps on banks shall be stapled across the slope at 6-inch intervals.
   4. Top dress jute netting area with a thin layer of topsoil. After the top dressing, the yarns shall still be visible.
   5. Spread loose topsoils over outside edges of netting to allow for smooth entry of water.
   6. Clods that hold the jute off the ground shall be stamped into the soil. Force jute netting down into depressions and hold there with a staple.
   7. Install plant material through netting.
   8. Maintenance: Maintain jute netting until work on the Project has been completed and accepted and during the 90-day maintenance period. Maintenance shall consist of the repair of eroded areas and the repair or replacement and re-stapling of loose or undermined netting. Replace damaged planting materials as required.
   9. Install jute netting in all areas of 30 percent slope or greater.

3.08 SOD

A. Sod shall be laid with closely fitted joints on a smooth, level surface which has been prepared as previously specified. Ends of strips shall be staggered. On irregular areas, sod shall be laid in both directions from the longest straight line that can be drawn through the area.

B. After a light initial watering immediately after installation, the sod shall be rolled to eliminate all irregularities.

C. After compaction, the sodded area shall be wetted to a soil depth of at least 8 inches.

D. Sod shall be as specified on the Contract Drawings

E. Protect sod from pedestrian traffic for 21 days and from sports activity for 6 weeks.

F. Sod is to be rolled minimum two times or as often as required in two directions with a water ballast roller to remove variations in grade. Sand infill all depresses. Sand to comply with turf manufacturer recommendations.

G. Sod is to be machine placed from “Big Rolls”.

3.09 PLANTING

A. General
   1. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as approved by the Architect.
   2. Only as many plants as can be planted and watered on that same day shall be distributed in a planting area.
   3. Container shall be opened and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken and they shall be planted and watered as herein specified immediately after removal from the containers. Containers shall not be opened prior to placing the plants in the planting area.

B. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure acceptance by the Architect before start of planting work. Make minor adjustments as may be requested.

C. Excavation for Trees and Shrubs:
   1. Excavate pits, beds and trenches as shown in details on the Drawings.
   2. Roughen and score edges of planting pit to eliminate any glazing of the sides of the pit.
   3. Field Samples: Prior to planting, prepare one plant pit with standpipe, gravel, filter fabric, and root barriers for each tree size to be reviewed by the Architect.
   4. Do not cover standpipes.
   5. Excavation for planting shall include the stripping and stockpiling of all acceptable topsoil encountered within the areas to be excavated for trenches, tree pits, plant pits, and planting beds.

D. Container Removal
   1. Cut containers on two sides with an acceptable cutter. Do not cut containers with spade or ax. Do not injure the rootball.
   2. Carefully remove plants from containers without injury or damage to rootball.
   3. After removing plants, superficially cut edge roots with knife on three sides.
   4. For plants with sensitive roots, place container intact in flat pit 1½ times the size of a standard plant pit. Insert blades of sharp, needle-nose shears into a drain hole and cut the container bottom away. Remove bottom from pit. Follow with a cut down one side of the container from top to bottom. Repeat cut on opposite side. Fill plant pit with prepared plant pit mixture. Carefully remove the detached pieces.

E. Box Removal:
   1. Remove bottom of planting boxes before planting.
   2. Remove sides of box without damage to rootball after positioning plant and partially backfilling.

F. Planting Trees and Shrubs: Set container-grown stock, plumb and in center of pit or trench. Set top of rootball 2-inches above finish grade at trees, 1-inch above finish grade at shrubs, or as indicated on Contract Drawings. Do not use plant, if root system has severely kinked or circling roots, or if rootball is cracked, disturbed or broken. If root system is healthy, loosen spiraling roots and set in plant pit.

G. Planting pit shall be backfilled with the following soil conditioner and organic amendment, per cubic yard:
   1. Application Rates, (FOR BID PURPOSES ONLY)as determined by contractor's soils tests:
      a. Potassium Sulfate - 0-0-50, ¼-pound
      b. Single Superphosphate - 0-20-0, ¼-pound
      c. Ammonium Sulfate - 21-0-0, ¼-pound
      d. Compost - 15% by volume
      e. Agricultural Gypsum - 1.5 pounds
      f. Good Humus - 15% by volume
   2. Final amendments and rates are to be determined by Agronomic Soils Test.

H. When set, place additional fill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 1/2-full, place appropriate number of fertilizer tablets and complete backfill operations.

I. After backfilling, an earthen basin shall be constructed around each plant. Each basin shall be as indicated on the Contract Drawings. Basin shall be of a size suitable for the individual plant. In no case shall the basin for fifteen (15) gallon plant be less than four (4) feet in diameter; a five (5) gallon plant less than three (3) feet in diameter. The basins shall be constructed of amended backfill materials, and shall not be constructed for trees in turf areas.

J. Repeat watering until no more is absorbed.

K. Apply pre-emergent herbicide as per manufacturer's recommendations to all shrub and ground cover planting areas after planting.

L. Mulch all planted areas that do not receive jute netting, other than lawn areas, at not less than 3" thickness of mulch.
   1. Areas with 30% slope and greater shall be protected with jute mesh.

M. Equally space and align trees and shrubs in both directions where designated on Contract Drawings.

N. Pull bark mulch three (3) inches away from the rootballs of all plants to insure proper air circulation.

O. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practices. Prune trees and other plantings only if required. Pruning shall be limited to remove injured wigs and branches, and to compensate for loss of roots during transplanting, but never exceed 1/3 of the branch structure. Never prune without prior review with Architect.

P. Prune shrubs to retain natural character. Unless directed by the Architect, do not prune leaders or apices of any plant material. Do not prune into balled or boxed forms without prior written approval of the Architect.

Q. Remove and replace excessively pruned or malformed stock resulting from improper pruning.

R. Planting Ground Cover
   1. Space plants as shown or scheduled.
   2. Dig holes large enough to allow for spreading of roots and compact area around plant. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.
   3. Mulch areas between ground cover plants with not less than three (3) inch deep mulch.

S. Miscellaneous Landscape Work: Install headers and edgings where shown. See appropriate details.

T. Planting Vines: Plant in accordance with details. Attach vine to vertical elements with vine ties as per manufacturer's recommendations.

U. Tree Staking and Guying: Stake or guy all trees per landscape details, and tie with tree ties as specified. Remove all nursery stakes from trees unless directed otherwise by the Architect. Immediately after planting, stake and guy all trees in accordance with details indicated on Contract Drawings. One tree of each size shall be staked and guyed, and reviewed by Architect prior to continue work.

V. Hardpan Conditions
   1. Where hardpan exists, whether it is in the form of caliche, rock or other impervious matter, and it is within the top 2½ feet of soil, or within the plant pit, use powered equipment to break through completely at each plant location to allow drainage and root growth. Remove hardpan at least 1½ feet greater than the rootball diameter of plant. Backfill with soil mix as specified.
   2. Where hardpan is within the first 12-inches of soil, it shall be completely penetrated for all trees and shrubs.

3.10 CLEANUP AND PROTECTION:

A. During landscape work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, and or other material from landscape planting and/or maintenance period.

B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and/or other trades. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

C. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks and provide a clean surface.

3.11 REVIEW & FINAL ACCEPTANCE

A. General: Notify Landscape Architect at least 5 days in advance when requesting on-site reviews.

B. Site Observation requirements:
   1. Punch list at completion of landscape/irrigation work.
      a. Review of grading, irrigation and planting.
      b. Upon completion of punch list items the Maintenance Period begins.
         1) The maintenance period will not begin until all punchlist items are resolved and acceptance is provided by the Landcape Architect in writing.
   2. Final acceptance of project (at end of Maintenance Period).
      a. Review of grading, irrigation and planting.
      b. Upon completion of punch list items to the Client and Landscape Architect's satisfaction, the work is deemed completed.
   3. The maintenance period will not begin until all punchlist items are resolved and acceptance is provided by the architect in writing.
   4. Refer to Division 32 Section "Landscape Maintenance."
   5. Where observed work does not comply with the Plans and Specifications, replace rejected work and continue specified maintenance period until reinspected by the Landscape Architect and determined to be acceptable. All replacement materials and installations shall be in accordance with the Plans and Specifications. Remove rejected work and materials immediately from project. Prior to the date of final observation, Contractor shall provide the Landscape Architect with all Record Drawings in accordance with the Plans and Specifications.
   6. Replace non-compliant and/or rejected work prior to final observation.
   7. Prior to the date of final observation, Conractor sahll provide the Landdscape Architect with all Record Drawings in accordance with the Plans and Specifications.

3.12 REPLACEMENT

A. All plant material and other materials installed under the Contract shall be warranteed against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are noted in Part of this Specification.
   1. Trees, vines, and shrubs: One Year
   2. Groundcover and Turf: One Year
   3. Replacement: Any materials found to be dead, missing, or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect. All replacement materials and installations shall comply with the Plans and Specifications.
      a. As soon as weather condtions permit, replace work that does not comply with the Plans and Specifications, without cost to the Owner. Remove rejected and non-compliant work and mateirals immediately from the project. Continue specified maintenance period until reinspected by the Landscape Architect and dtermeined to be acceptable.

b. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the Landscape Architect that security on this site needs to be intensified.

4. Contractor to schedule replacement work with the Owner's representative, and arrange for proper staging and access.
   a. Contractor to include re-inspaection dats as part of replacment work scheduling.
5. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the Landscape Architect shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

END OF SECTION

SECTION 331416
SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Site water distribution system complete with valves and distribution pipelines from water supply mains to points of connection.

1.02 RELATED REQUIREMENTS

A. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

B. Project Geotechnical Report.

1.03 REFERENCE STANDARDS

A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

B. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2024.

C. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2024.

D. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.

E. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.

F. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.

G. AWWA C504 - Rubber-Seated Butterfly Valves; 2023.

H. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS; 2025.

I. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.

J. AWWA C800 - Underground Service Line Valves and Fittings; 2021.

K. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.

L. AWWA C651 Disinfecting Water Mains.

M. AWWA C110 Ductile-Iron and Gray-Iron Fittings

N. AWWA C153 Ductile-Iron Compact Fittings

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's catalog cuts for pipe, fittings, joint couplings; Backflow preventers and assemblies, fire hydrants; water meters and accessories; valves; and valve boxes.

1.05 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to the requirements indicated:
   1. Notify Owner's Representative not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's Representative written permission.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with utility company supplying water requirements.

B. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.

C. The Contractor shall have a copy of the Standard Specifications at the job site.

D. Piping materials shall bear label, stamp, or other markings of specified testing agency.

E. NSF Compliance:
   1. Comply with NSF 14 for plastic potable-water-service piping.
   2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Do not store materials directly on the ground. Support the pipe uniformly during shipping and storage. Do not stack higher than 4 feet nor stack with weight on bells. Cover the pipe with plastic to protect it from sunlight. Keep inside of pipe and fittings free of dirt and debris. Avoid scratching the pipe surface.

B. Take special care to avoid damage to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged.

C. Prior to installation, each pipe length shall be carefully inspected for damage.

D. All pipe, fittings, and appurtenances shall be thoroughly cleaned before installation and shall be kept clean until installation and backfilling has completed.

E. Use only nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.

F. Keep the pipe clean and free of debris, dirt, animals, and trash during and after laying operations.

G. At the close of each operating day, seal the open end of the pipe using a gasketed night cap.

PART 2 PRODUCTS

2.01 WATER PIPE

A. PVC Pipe (NPS 1"-3"): ASTM D1785 Schedule 80.
   1. Fittings: ASTM D2467, PVC.
   2. Joints: ASTM D2855, solvent weld.

B. PVC Pipe (NPS 4"-12"): AWWA C900 Class 235:
   1. Ductile Iron Mechanical Joint Fittings: AWWA C110 Ductile Iron and Gray-Iron Fittings or AWWA C153 Ductile Iron Compact Fittings

2. Gaskets: AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
3. Joints: ASTM D3139 compression gasket ring.

C. Pipe for potable water use shall be blue, or dark grey in color. Pipe for recycled or reclaimed water use shall be purple in color.

D. Tracer Wire: #8 AWG Type UF (direct burial) stranded single conductor cable with high density polyethylene (HDPE) or high molecular weight polyethylene (HMWPE) insulation. The insulation shall be black in color.

E. Detectable Warning Tape: Per Section 312316.13.

2.02 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Gate Valves Up To 3 Inches:
1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, ends, with control rod, and extension box.

C. Gate Valves 3 Inches and Over:
1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, ends, control rod, and extension box.

2.03 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Project Geotechnical Report, and contract drawings.

B. Cover: As specified in Project Geotechnical Report, and contract drawings.

2.04 ACCESSORIES

A. Concrete for Thrust Restraints: As specified in the water purveyor supplying water standard specifications, or Standard Specifications for Public Works Construction; latest edition.

2.05 CORROSION-PROTECTION ENCASEMENT FOR PIPING

A. Polyethylene Encasement for Underground Ductile-Iron Pipe and Fittings: Polyethylene encasement of eight mils thickness shall conform to AWWA C105. Joint tape shall be self sticking PVC or polythylene, eight mils thick.

B. Fusion-Bonded Epoxy Coatings for Ductile-Iron and Gray-Iron Fittings: Epoxy coating shall conform to AWWA C116.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to beginning work, verify that building service connection and municipal and site water main size, location, and invert are as indicated.

B. Examine trench bottom to ensure that it is accurately graded to provide uniform bearing and to support pipe.

3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. See the contract drawings for additional requirements.

B. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide applicable square feet thrust restraint bearing on subsoil per contract drawing details and references.

D. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraint bearing on subsoil, size as indicated.

E. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

A. Project site water lines shall terminate approximately five feet from buildings, unless otherwise indicated on contract drawings. Install temporary cap or plug terminals for future connection to building.

B. Bury piping with depth of cover over top at least 36 inches, unless otherwise indicated per the contract drawings.

C. Install underground piping with restrained joints at horizontal and vertical changes in direction, where line size is 4 inches and larger. Use retrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports for all lines NPS 3 or greater.

D. Maintain separation of water main from sewer piping in accordance with applicable codes, jurisdicational requirements and the following:
   1. Lay water mains over sanitary sewer lines to provide vertical separation a miminum of 12 inches.
      a. If 12 inch minimum separation cannot bet met:
         1) Install water line with all joints located at least 10 feet from each side of the sewer pipe.
         2) Encase sewer in 6 inches of concrete around pipe extended to 10 feet of either side of water pipe.

E. Install pipe to indicated elevation to within tolerance of 1/2 inches.

F. All pipe shall be laid true to line and grade as shown on the contract drawings.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Install detectable warning tape per design drawing trenching detail. and Section 312316.13.

I. Install tracer wire on top of pipe per design drawing trenching detail. Tape tracer wire to pipe every 10 feet.
   1. Wire shall be continous strand. Crimpable copper butt splice kits are permitted in valve cans only. At valve cans, wire shall be routed up the outside of the valve riser, into the valve can at the top, 12-inch looped, and back down the outside of the valve riser.
   2. Wire shall terminate at surface in an in ground traffic rated access box labeled "Water".

3.05 INSTALLATION - VALVES

A. Set valves on solid bearing.

B. Center and plumb valve box over valve. Set box cover flush with proposed finished grade.

3.06 FIELD QUALITY CONTROL

A. See Section , for additional requirements.

B. Potable Water:
   1. Perform hydrostatic testing on private and public water piping as required by the local water purveyor supplying water.
   2. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

C. Perform Tracer Wire Continuity Tests.

D. Prepare reports of all testing activities.

3.07 CLEANING

A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

B. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651.

END OF SECTION

SECTION 333113
SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewerage drainage piping, fittings, and accessories.

B. Connection of building sanitary drainage system to existing onsite sewer system.

1.02 RELATED REQUIREMENTS

A. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

B. Project Geotechnical Report.

1.03 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.04 REFERENCE STANDARDS

A. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

1.05 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to the requirements indicated:
   1. Notify Owner's Representative not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's Representative written permission.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating pipe, pipe accessories,and other sewer components as indicated.

C. Field Quality Control Submittals: Document results of field quality control testing.

D. Project Record Documents:
   1. Record location of pipe runs, connections, and invert elevations.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

A. Provide products that comply with applicable code(s).

B. Plastic Pipe: ASTM D3034, SDR 35, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter as indicated, bell and spigot style rubber gasket joints.

C. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

A. Detectable Warning Tape: Per Section 312316.13.

2.03 BEDDING AND COVER MATERIALS

A. Bedding Material: As specified in Project Geotechnical Report, and contract drawings.

B. Cover Material: As specified in Project Geotechnical Report, and contract drawings.

PART 3 EXECUTION

3.01 GENERAL

A. Perform work in accordance with applicable code(s).

3.02 **EXAMINATION**

A. Prior to beginning work, verify that building service connections, municipal and site storm main size, location, and invert are as indicated.

3.03 TRENCHING

A. See Project Geotechnical Report for additional requirements.

B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

D. Do not interfere with 45 degree bearing splay of foundations.

E. Cut trenches wide enough to allow inspection of installed utilities.

F. Hand trim excavation for accurate placement of pipe to elevations indicated.

G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

H. Remove excess excavated material and material that is unsuitable for re-use from site.

I. Stockpile excavated material to be re-used in area designated on site.

J. Provide temporary means and methods, as required, to remove all water from trenching. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

K. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.04 INSTALLATION - PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
   1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.

E. Install continuous detectable warning tape 12 inches above top of pipe.

3.05 INSTALLATION - CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.

C. Establish elevations and pipe inverts for inlets and outlets as indicated.

D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 014000.

B. Do not enclose, cover, or put into service before inspection and approval.

C. Tests: Upon completion of this portion of the work, and prior to accepatance by the owner, perform all required tests and secure approvals from agencies having jurisdiction.

D. Submit separate reports for each system inspection and test.

E. Defects requiring correction include the following:
   1. Alignment: Less than full diameter of inside of pipe is visible between structures.
   2. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   3. Infiltration: Water leaking into piping.
   4. Exfiltration: Water leakage from or around piping.
   5. Leaks and loss in test pressure constitute defects that must be repaired.

F. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

G. Reinspect and repeat procedure until results are satisfactory.

H. Gravity-Flow Sewer Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   1. Option: Test according to requirements set forth in ASTM F 1417.

3.07 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 334211
STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gravity-flow, nonpressure site stormwater drainage piping.

B. Stormwater pipe accessories.

1.02 RELATED REQUIREMENTS

A. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

B. Project Geotechnical Report.

1.03 REFERENCE STANDARDS

A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

B. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

C. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.

D. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.

E. Standard Specifications for Public Works Construction (Greenbook); current edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating pipe, pipe accessories, and other drain components as indicated.

C. Field Quality Control Submittals: Document results of field quality control testing.

D. Project Record Documents:
   1. Record location of pipe runs, connections, and invert elevations.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to the requirements indicated:
   1. Notify Owner's Representative not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's Representative written permission.

PART 2 PRODUCTS

2.01 **STORM DRAINAGE PIPE MATERIALS**

A. Plastic Pipe: ASTM D3034, Type PSM, SDR 35 Poly Vinyl Chloride (PVC) material; inside nominal diameter of 4-10 inches, bell and spigot style gasketed sealed joint ends.

B. Cast in Place Concrete: Greenbook Section 201-1.

2.02 PIPE ACCESSORIES

A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

B. Detectable Warning Tape: Per Section 312316.13.

2.03 BEDDING AND COVER MATERIALS

A. Bedding Material: As specified in Project Geotechnical Report, and contract drawings.

B. Cover Material: As specified in Project Geotechnical Report, and contract drawings.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Prior to beginning work, verify that building service connection and municipal and site utility water main size, location, and invert are as indicated.

3.02 TRENCHING

A. See Section 312316 - Excavation and Section 312323 - Fill for additional requirements.

B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

D. Do not interfere with 45 degree bearing splay of foundations.

E. Cut trenches wide enough to allow inspection of installed utilities.

F. Hand trim excavation for accurate placement of pipe to elevations indicated.

G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

H. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume.

I. Remove excess excavated material and material that is unsuitable for re-use from site.

J. Stockpile excavated material to be re-used in area designated on site.

K. Provide temporary means and methods, as required, to remove all water from trenching. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

L. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.03 INSTALLATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
   1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.

E. Install continuous detectable warning tape 12 inches above top of pipe.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection in accordance with Section 014000 - Quality Requirements.

B. Do not enclose, cover, or put into service before inspection and approval.

C. Tests: Upon completion of this portion of the work, and prior to acceptance by the owner, perform all required tests and secure approvals from agencies having jurisdiction.
   1. Submit separate reports for each system inspection and test.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5% of internal piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leaking into piping.
      e. Exfiltration: Water leakage from or around piping.
      f. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.
   5. PVC Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      a. Option: Test according to requirements set forth in ASTM F 1417.

3.05 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION