

PROJECT MANUAL

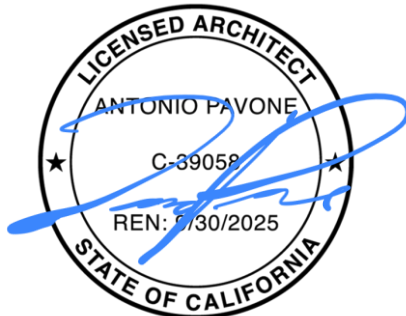
Golden Plains Unified School District Tranquillity High School Aquatic Center Modernization Increment 1

6052 Juanche Ave, Tranquillity California 93668
DSA Application No.: 02-123309



791:	Project Number
100% CD DSA Approval:	Project Phase
8/6/2025:	Issue Date

SECTION 000102
SEALS PAGE



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END OF SECTION

SECTION 010000
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 ADDENDA

- A. Article includes administrative requirements for Addenda issued prior to bid opening.
- B. Related Requirements:
 - 1. Division 00 Sections as applicable to contract requirements and modifications.
 - 2. Division 01 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 3. Division 01 Section "Contract Modification Procedures" for changes to the Contract Documents after award of the Contract.
- C. Notice to bidders
 - 1. Addenda will be issued to registered plan holders for changes to the drawings and specifications during the bidding period prior to the bid opening. Addenda shall serve to clarify, revise, and supersede information in the Project Manual, Drawings, and previously issued Addenda. Portions of the Addenda affecting the Contract Documents will be incorporated into the Contract by enumeration of the Addendum in the Owner/Contractor Agreement.
 - 2. The Bidder shall acknowledge receipt of this Addendum in the appropriate space on the Bid Form.
- D. Governing Agency Review and Approval
 - 1. Addenda shall be submitted to the Authority having Jurisdiction (AHJ) by the project Architect and shall be approved by the AHJ in order to be officially incorporated into the construction documents.

1.2 REQUEST FOR INFORMATION

- A. Article includes administrative provisions for preparation, submittal and response to Contractor's Request for Information (RFI's) during construction of project.
- B. Definitions
 - 1. RFI, Request for Information: Request from Contractor seeking information required by or clarification of the Contract Documents.
- C. Submittals
 - 1. RFI Submittals: Submit RFI's via email as PDF electronic files; include attachments in PDF electronic file format.

D. Request for Information (RFI's)

1. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - a. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 - b. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

E. Content of the RFI:

1. Include a detailed, legible description of item needing information or interpretation and the following:
 - a. Project name.
 - b. Project Number.
 - c. Date.
 - d. Name of Contractor.
 - e. Name of Architect.
 - f. RFI number, numbered sequentially.
 - g. RFI subject.
 - h. Specification Section number and title and related paragraphs, as appropriate.
 - i. Drawing number and detail references, as appropriate.
 - j. Field dimensions and conditions, as appropriate.
 - k. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - l. Contractor's signature.
 - m. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - 1) Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

F. Architect's Action:

1. Architect will review each RFI, determine action required, and respond.
 - a. Allow 10 working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 - b. Architect will not act on any RFI's until 7 days following the submission of the Schedule of Values per Division 01 Section "Payment Procedures".
 - c. The following RFIs will be returned without action:
 - 1) Request for approval of submittals.

- 2) Request for approval of substitutions.
 - 3) Request for approval of Contractor's means and methods.
 - 4) Request for coordination information already indicated in the Contract Documents.
 - 5) Request for adjustments in the Contract time or the Contract sum.
 - 6) Request for interpretation of Architect's actions on submittals.
 - 7) Incomplete RFI's or inaccurately prepared RFIs.
- d. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
- e. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures".
- 1) If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- f. Distribution: The Architect shall distribute one electronic copy of each completed RFI review to the Contractor and the Owner.
- g. Regulatory Requirements: Architect's responses that modify the Contract Documents affecting Structural Safety, Fire and Life Safety, and/or Access Compliance shall be submitted to the Division of the State Architect for review and approval.
- 1) Changes to DSA approved Construction Documents shall be as specified in Division 01 Section "Contract Modification Procedures".
- h. RFI Log Prepare, maintain, and submit a tabular log of RFIs organized by the sequential RFI number. Submit log weekly unless otherwise directed in writing by Architect. Include the following.
- 1) Project name.
 - 2) Name and address of Contractor.
 - 3) Name and address of Architect.
 - 4) RFI number (sequentially) including RFI's that were returned without action or withdrawn.
 - 5) RFI description.
 - 6) Date the RFI was submitted.
 - 7) Date Architect's response was received.
- i. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within 7 days if Contractor disagrees with response.
- j. Contractor's Expense for RFI's: Architect will review and respond to legitimate RFI's at no additional cost to the Contractor. RFI's determined by the Architect to be flagrant or unnecessary will have the expense for the Architect's time paid by the Owner with the amount being deducted from the Contract Sum. The expense will be based on an hourly rate in

accordance with the Architect's standard hourly rate schedule in effect at the time the work is performed with a minimum of one hour for each flagrant or unnecessary RFI.

1.3 DSA HOURLY FEE SERVICES

- A. Article includes administrative and procedural requirements for DSA Hourly Fee Services associated with changes to DSA approved Construction Documents.
- B. Related Documents
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
 - 2. Division of the State Architect (DSA) Interpretive Regulation IR A-30 "DSA Hourly Fee Services" latest edition (Document is available on DSA's website under "Publications;" Interpretive Regulations (IRs); A- Administrative; IR-30).
- C. DSA Hourly Fee Services
 - 1. General: Changes to DSA approved Construction Documents shall be documented by the use of DSA Construction Change Document (CCD) forms. CCD forms shall be submitted to DSA by the Architect.
 - a. Refer to Division 01 Section "Contract Modification Procedures" for additional information regarding DSA CCD's.
 - 2. DSA Hourly Fee Services: Changes to DSA approved Construction Documents shall be reviewed by DSA and shall be subject to DSA Hourly Fee Services for review at a rate established by DSA IR A-30. Charges will be made to the Owner by DSA.
 - a. Hourly Rate: Rate per hour as established by DSA IR A-30, latest edition.
 - 3. Bidder's Responsibility: Prior to bidding, where a bidder's request for substitution or similar action results in a change requiring DSA Hourly Fee Services, bidder shall submit a deposit to the Architect for reimbursement for DSA Hourly Fee Services. The deposit amount shall be established by the Architect, a minimum of one hour of DSA Hourly Fee Services (hourly rate as established by DSA IR A-30) will not be refundable. Deposits shall be made payable to the Owner.
 - 4. Contractor's Responsibility: When a contractor's action results in a change requiring DSA Hourly Fee Services, charges by DSA to the Owner will be deducted from the Contract Sum and the Architect will issue a Change Order on a quarterly basis to adjust the Contract Sum.

1.4 WARRANTIES

- A. Article includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers' standard warranties on products

and special warranties.

B. Definitions

1. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
2. Special project warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

C. Warranty Requirements

1. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
2. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
3. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
4. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
5. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - a. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
6. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

D. Submittal of Project Warranties

1. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than

- date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
2. Warranty Submittal: Submit (2) paper copies and one electronic copy of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer.
 - a. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - b. Provide additional copies of each warranty in operation and maintenance manuals.
 3. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - a. Submit by email to Architect.
 4. Warranties in Paper Form
 - a. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - b. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - c. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 011000
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Work under Owner's separate contracts.
6. Owner's product purchase contracts.
7. Owner-furnished/Contractor-installed (OFI) products.
8. Contractor-furnished/Contractor-installed (CFI) products.
9. Contractor's use of site and premises.
10. Coordination with occupants.
11. Work restrictions.
12. Specification and Drawing conventions.
13. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.2 PROJECT INFORMATION

A. Project Identification: 791 Tranquillity High School Aquatic Center Modernization.

1. Project Location: 6052 Juancha Ave, Tranquillity, CA 93668.

B. Owner: Golden Plains Unified School District.

1. Owner's Representative: Victor Martinez, vmartinez@gpusd.org.

C. Architect: Tony Pavone, AGD Architects, tony@andrewgoodwin.us.

D. Construction Manager: Central Valley Construction Management.

1. Construction Manager Representative: Blanca Mercedes, bmercedes@centralvalleycm.com.
2. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between

Owner and Construction Manager.

- a. Construction Manager also serves as Project coordinator, as defined in Section 011200 "Multiple Contract Summary."

E. Design-Builder: SAS Constructions.

- 1. Design-builder has been engaged for Increment 2 Building 'Q' of this Project to provide architectural and engineering services and to serve as Project's constructor of the buildings. The terms "design-builder" and "Contractor" are synonymous.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

- 1. Increment 1 project scope includes new cmu masonry pool equipment building, Myrtha Modular 10-lane competition pool, Myrtha renovation learn to swim pool, 20-foot water slide, kids splash and play area, softball scoreboard, perimeter fencing, landscape, associated site lighting, and other Work indicated in the Contract Documents.

B. Type of Contract:

- 1. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a list of multiple contracts, a description of work included under each of the multiple contracts, and the responsibilities of Project coordinator.

1.4 WORK UNDER OWNER'S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

B. Concurrent Work: Owner has awarded separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.

- 1. Increment 2: To SAS Constructions for construction of building Q and R.

1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

- 1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and

- Samples.
 - 2. Provide for delivery of Owner-furnished products to Project site.
 - 3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
 - 4. Obtain manufacturer's inspections, service, and warranties.
 - 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
- 1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
 - 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
 - 3. Receive, unload, handle, store, protect, and install Owner-furnished products.
 - 4. Make building services connections for Owner-furnished products.
 - 5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 - 6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFCl) Products:
- 1. Myrtha Pool System components for 10-lane swimming pool and learn to swim pool

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- 1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period.

Repair damage caused by construction operations.

- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy Project site and existing adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend Hours: Submit a written request to the Architect for work hours outside of the indicated on-site work hours..
 - 2. Early Morning Hours: Submit a written request to the Architect for work hours outside of the indicated on-site work hours..
 - 3. Work in Existing Building: Shall be coordinated with Owner and site staff. Submit a written request to the Architect for work hours outside of the indicated on-site work hours..
 - 4. Work outside of the indicated on-site work hours are subject to review by the Owner
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Architect Construction Manager Owner not less than two business days in advance of proposed utility interruptions.
 - 2. Obtain Architect's Construction Manager's Owner's written permission before

proceeding with utility interruptions.

- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Architect Construction Manager Owner not less than two business days in advance of proposed disruptive operations.
 - 2. Obtain Architect's Construction Manager's Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site is not permitted.
- F. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
 - 1. The most restrictive requirements shall apply where conflicts occur between Division 00 Contracting Requirements and Division 01 General Requirements; Architect shall make the final decision on which requirement(s) are applicable.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on

Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Provide heavy duty commercial grade products and materials where requirements for materials and products indicated on the Drawings are not specified.

1.10 PROJECT SCHEDULE

- A. See schedule provided included in contract documents .

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 011200
MULTIPLE CONTRACT SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a summary of each contract, including responsibilities for coordination and temporary facilities and controls.
 - 1. Increment 1 Site Work Contract
 - 2. Increment 2 Building Q Contract
- B. Specific requirements for Work of each contract are also indicated in individual Specification Sections and on Drawings.
- C. Related Requirements:
 - 1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site, phased construction, coordination with occupants, and work restrictions.
 - 2. Section 013100 "Project Management and Coordination" for general coordination requirements.

1.2 PROJECT COORDINATOR

- A. Coordinators: The Contractor for each contract shall appoint a project coordinator to be responsible for coordination of each contractor's work with other contractors.

1.3 PROJECT COORDINATOR RESPONSIBILITIES

- A. Project Coordinator shall perform project coordination activities including, but not limited to, the following:
 - 1. Work between contracts
 - 2. Access to shared or common work spaces.
 - 3. Temporary facilities and controls.
 - 4. Interruptions, approved or otherwise, of permanent and temporary utilities, including those necessary to make connections for temporary services.
 - 5. Construction and operations of the Work with work performed by each Contract.
 - 6. Prepare coordination drawings in collaboration with each contractor to coordinate work by more than one contract.
 - 7. Provide quality-assurance and quality-control services specified in Section 014000 "Quality Requirements."
 - 8. Sequence of activities to accommodate tests and inspections, and coordinate schedule of test and inspections as applicable to respective Work.
 - 9. Information necessary to adjust, move, or relocate existing utility structures

- affected by construction.
10. Locate existing permanent benchmarks, control points, and similar reference points, and establish permanent benchmarks on Project Site
 11. Provide progress cleaning of common areas and coordinate progress cleaning of areas or pieces of equipment where more than one contractor as worked.
 12. Protection of the Work.
 13. Completion of interrelated punch list items.
 14. DSA Project Closeout Procedures.

1.4 GENERAL REQUIREMENTS OF CONTRACTS

- A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of Project.
1. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
 2. Trenches and other excavation for the work of each contract shall be the work of each contract for its own work.
 3. Painting for the work of each contract shall be the work of each contract for its own work.
- B. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Section 015000 "Temporary Facilities and Controls," each contractor is responsible for the following:
1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.
 2. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.
 3. Its own field office, complete with necessary furniture, utilities, and telephone service.
 4. Its own storage and fabrication sheds.
 5. Temporary enclosures for its own construction activities.
 6. Staging and scaffolding for its own construction activities.
 7. General hoisting facilities for its own construction activities, up to 2 tons.
 8. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
 9. Progress cleaning of work areas affected by its operations on a daily basis.
 10. Secure lockup of its own tools, materials, and equipment.
 11. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
- C. Temporary Heating, Cooling, and Ventilation: Contractor of each contract is responsible for temporary heating, cooling, and ventilation, including utility-use charges, temporary meters, and temporary connections.

1.5 INCREMENT 1 SITE WORK CONTRACT

- A. Work of the Site Work Contract includes, but is not limited to, the following:
1. Remaining work not identified as work under other separate contracts.
 2. Selective demolition of site improvements as indicated on drawings and as necessary to accommodate the completion of the Work.
 3. Site preparation: site clearing, earthwork including over excavation and backfill in preparation for construction of building pads for buildings P and Q, pre-manufactured shade structure, waterslide and splashpad equipment
 - a. Excavation for building Q footings after pads have been prepared shall be the responsibility of the Increment 2 Building contractor.
 4. Site improvements including: fencing, gates, lighting, landscape, irrigation and utilities
 5. Site utilities, trenching, backfill, and patching.
 6. Modular pool construction
 7. Dive pool conversion
 8. Pool equipment building
 9. Softball field scoreboard
 10. Water slide
 11. Shade structure
 12. Splash pad
 13. Concrete paving and walks
- B. Temporary facilities and controls of the Increment 1 Site Work Contract include, but are not limited to, the following:
1. Temporary facilities and controls that are not otherwise specifically assigned to other separate contracts.
 2. Sediment and erosion control.
 3. Temporary toilet, wash, and drinking facilities, including disposable supplies.
 4. Temporary signs and project identification.
 5. General waste disposal facilities.
 6. Temporary fire-protection facilities.
 7. Warning signs, barricades and lights.
 8. Site enclosure fencing and gates.
 9. Security enclosure and lockup.
 10. Environmental protection.
 11. Daily restoration of Owner's existing facilities used as temporary facilities.
- C. Plumbing Work of the Increment 1 Site Work Contract includes, but is not limited to, the following:
1. Site water distribution, sewers, and storm drainage as indicated on the drawings.
 - a. Site water distribution, sewers, and storm drainage shall extend and shall be connected to points of connection for Increment 2 building contract.
 - 1) Under slab utilities of buildings are the responsibility of the Increment

2 building contractor.

- b. Waterslide and splash pad utility connections are the responsibility of the Increment 1 site work contractor.

- 2. Coordination and permitting of sewer and storm drainage tie into City right-of-way.

- D. Electrical Work of Increment 1 Site Work Contract includes, but is not limited to, the following:

- 1. Remaining work not identified as work under other contracts.
- 2. Site electrical distribution.
- 3. Site lighting
- 4. Pre-manufactured shade structure lighting.
- 5. Site communications and security.
- 6. Electrical service and distribution.
- 7. Fire alarm systems and devices.

1.6 INCREMENT 2 BUILDING CONTRACT

- A. Work of Increment 2 Buildings Contract includes, but is not limited to, the following.

- 1. On site construction of buildings as indicated on the DSA approved Increment 2 drawings.
- 2. Under slab waste piping as indicated on the drawings.
- 3. Floor sinks, floor drains, and trap primer piping shall be furnished, set in place and cast in slabs under this portion of the work.
- 4. Excavation and over-excavation for footings.
- 5. Cast-in-place concrete footings and slab
- 6. Plumbing, Mechanical and Electrical work as indicated on drawings
- 7. Removal of excess soil excavated

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012500 SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form of standard practice that is acceptable to Architect.
 - 2. Substitutions Prior to Bid: Architect will consider requests for substitution if received within the 3 days following the job walk prior to submission of bids. Requests received after that time may be considered or rejected at discretion of Architect
 - a. Substitutions prior to bid shall also be subject to the requirements of applicable Division 00 Specification Sections.
 - b. Substitutions prior to bid shall comply with the requirements for Substitutions for Cause or Substitutions for Convenience as applicable.

3. Substitutions After Award of Contract: The Contractor after award of the Contract, as allowed by the General Conditions, may submit materials and methods to be considered for substitutions.
 - a. The following are not considered to be Substitutions.
 - 1) Revisions to the Contract Documents requested by the Owner or Architect.
 - 2) Specified options of products and construction methods included in the Contract Documents.
 - 3) The Contractor's compliance with governing regulations and orders issued by governing authorities.
4. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may

subsequently become necessary because of failure of proposed substitution to produce indicated results.

5. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor[**through Construction Manager**] of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Forms of Acceptance:

- 1) Substitutions Prior to Bid: Addenda will be issued for substitutions accepted prior to bid.
- 2) Substitutions After Award of Contract: Change Order, Construction Change Directive or Architect's Supplemental Instructions for minor changes in the work.

- b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

6. Architect will consider request for substitution if received 20 days prior to the submission of bids. Request received after indicated timeline may be considered or rejected at the discretion of the Architect.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 20 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

- b. Requested substitution provides sustainable design characteristics, as required, that specified product provided for compliance with Agencies identified in other divisions and sections of this Project Manual.
- c. Substitution request is fully documented and properly submitted.
- d. Requested substitution will not adversely affect Contractor's construction schedule.
- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
- f. Requested substitution is compatible with other portions of the Work.
- g. Requested substitution has been coordinated with other portions of the Work.
- h. Requested substitution provides specified warranty.
- i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience:

- 1. Architect will consider requests for substitution if received within 60 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.
 - a. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - 1) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - 2) Requested substitution does not require extensive revisions to the Contract Documents.
 - 3) Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 4) Requested substitution provides sustainable design characteristics that specified product provided for compliance with specified Agency listed in other Divisions and section of this Project Manual.
 - 5) Substitution request is fully documented and properly submitted.
 - 6) Requested substitution will not adversely affect Contractor's construction schedule.
 - 7) Requested substitution has received necessary approvals of authorities having jurisdiction.
 - 8) Requested substitution is compatible with other portions of the Work.
 - 9) Requested substitution has been coordinated with other portions of the Work.
 - 10) Requested substitution provides specified warranty.
 - 11) If requested substitution involves more than one contractor,

requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012600
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.2 GOVERNING AGENCY APPROVAL

- A. DSA Approval: Changes to DSA approved Construction Documents shall be reviewed and approved by DSA.
 - 1. Changes to DSA Approved Construction Documents shall comply with requirements of DSA Interpretive Regulation IR A-6, "Construction Change Document Submittal and Approval Process" and shall be accompanied by DSA Form 140 "Application for Submittal of Post-Approval Document".
 - a. Changes to Construction Documents include.
 - 1) Architects Supplemental Instructions.
 - 2) Architects Change Directive.
 - 3) Request for Proposals.
 - 4) Change Order Request.
 - 5) Cost Change Directive.
 - 6) Change Orders.
- B. Architect shall be responsible for preparing Construction Change Documents and submitting documentation to DSA.
- C. DSA Hourly Fee Services: Changes to DSA approved Construction Documents shall be reviewed by DSA and shall be subject to DSA Hourly Fee Services. Charges will be made to the Owner by DSA.

1.3 REQUIREMENTS OF CONTRACTOR

- A. Where changes to DSA approved Construction Documents are the result of actions by

the Contractor, the Contractor shall be liable for DSA Hourly Fee Services as described in Division 01 Section "General Requirements".

- B. Contractor shall perform the work indicated in the Architect's Supplemental Instruction without adjustment to the Contract Sum or the Contract Time. If the Contractor determines that an adjustment to the Contract Sum or the Contract Time is necessary due to the Architect's Supplemental Instruction, the Contractor shall respond to the Architect's Supplemental Instruction as if it were an Architect/Owner initiated Request for Proposal.
- C. Documentation by Contractor: Maintain detailed records on a time and material basis of work required from a contract modification.
 - 1. Documentation by Contractor: Maintain detailed records on a time and material basis of work required..

1.4 REQUIREMENTS OF ARCHITECT

- A. Within 7 days after receipt of Contractor's Change Order Request or Proposal Requests , Architect will:
 - 1. Issue a Change Order or Cost Change Directive for accepted proposals.
 - 2. Issue a Cost Change Directive for accepted Change Order Requests that do not require changes to the approved Construction Documents.
 - 3. Issue a Change Order and/or Cost Change Directive for accepted Change Order Requests that require changes to the approved Construction Documents.
 - a. Where Change Order Requests require changes to the Contract Documents, Architect will provide a detailed description of proposed changes in the Work via Change Order.
 - 4. Notify the Contractor of unaccepted proposals.
 - 5. Issue an Architect's Change Directive where changes are necessary for the progress of the Work and changes to the Contract Sum and the Contract Time are in dispute.

1.5 ARCHITECTS SUPPLEMENTAL INSTRUCTIONS

- A. Architect's Supplemental Instruction (ASI): Supplemental instructions will be issued by the Architect authorizing minor changes in the Work not involving adjustment to the Contract Sum or the Contract Time.
 - 1. Contractor shall perform the work indicated in the Architect's Supplemental Instruction without adjustment to the Contract Sum or the Contract Time. If the Contractor determines that an adjustment to the Contract Sum or the Contract Time is necessary due to the Architect's Supplemental Instruction, the Contractor shall respond to the Architect's Supplemental Instruction as if it were an Architect/Owner initiated Request for Proposal.

1.6 ARCHITECTS CHANGE DIRECTIVE

- A. Architect's Change Directive (ACD): Architect's Change Directives will be issued by the Architect instructing the Contractor to proceed with a change in the Work for subsequent inclusion in a Change Order.
 - 1. Architect's Change Directives contain a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time

1.7 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect , andConstruction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect , andConstruction Manager are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 7 after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect , andConstruction Manager.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of

the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.8 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.9 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect , andConstruction Manager will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.10 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect , andConstruction Manager may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012900 PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
 - 2. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.

- b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
- a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
- a. Differentiate between items stored on-site and items stored off-site.
5. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
6. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and Construction Manager and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the

Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect, Construction Manager and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Architect, and Construction Manager will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three Contractor signed digital copy of each Application for Payment to Architect, and Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction

period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Sustainable design action plans, including preliminary project materials cost data.
7. Schedule of unit prices.
8. Submittal schedule (preliminary if not final).
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
11. Copies of building permits.
12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
13. Initial progress report.
14. Report of preconstruction conference.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.

2. Certification of completion of final punch list items.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. Evidence that claims have been settled.
5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
6. Final liquidated damages settlement statement.
7. Proof that taxes, fees, and similar obligations are paid.
8. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013100
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Web-based Project management software package.
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
 - 2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names,

addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, [**in web-based Project software directory,**]and in prominent location in each built facility. Keep list current at all times.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination of Multiple Contracts: Each contractor shall cooperate with Project coordinator, who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.4 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Data Files Not Available: Architect will not provide Architect's BIM model digital data files for Contractor's use during construction.

- B. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in AutoCAD 2020.
 4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement.
 - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106.
 5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
 - c. Site Plans.
 - d. Topographic Survey's
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.5 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within three days of the meeting.

- B. Preconstruction Conference: **[Architect will schedule and conduct]** Architect and Owner Representative will schedule and conduct**[Construction Manager will schedule and conduct]****[Schedule and conduct]** a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises and existing building.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager of scheduled meeting dates.
 2. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 3. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Coordination of separate contracts.
 - m. Owner's partial occupancy requirements.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Construction Manager, and

Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period.

- b. Review present and future needs of each entity present, including the following:

- 1) Interface requirements.
- 2) Sequence of operations.
- 3) Status of submittals.
- 4) Deliveries.
- 5) Off-site fabrication.
- 6) Access.
- 7) Site use.
- 8) Temporary facilities and controls.
- 9) Progress cleaning.
- 10) Quality and work standards.
- 11) Status of correction of deficient items.
- 12) Field observations.
- 13) Status of RFIs.
- 14) Status of Proposal Requests.
- 15) Pending changes.
- 16) Status of Change Orders.
- 17) Pending claims and disputes.
- 18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

- F. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other

purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of RFIs.
 - 14) Proposal Requests.
 - 15) Change Orders.
 - 16) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
 - 2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
 - 3. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time **[belongs to Owner][is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date]**.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.

- G. Daily Construction Reports: Submit at weekly intervals.
- H. Material Location Reports: Submit at weekly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.

1.4 QUALITY ASSURANCE

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that is capable of managing construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of **[Substantial Completion][Final Completion]**.
 - 1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 - 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not

limited to, submittals, approvals, purchasing, fabrication, and delivery.

a. Pool Service Equipment.

4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 6. Commissioning Time: Include no fewer than 15 days for commissioning.
 7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Work under More Than One Contract: Include a separate activity for each contract.
 2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- F. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions

- have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.8 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.

6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013233
PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
 - 4. Time-lapse sequence construction photographs.
 - 5. Final Completion construction photographs.
 - 6. Preconstruction video recordings.
 - 7. Periodic construction video recordings.
 - 8. Time-lapse sequence construction video recordings.
 - 9. Construction webcam.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
 - 4. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
 - 5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in web-based Project management software site:
 - a. Name of Project.

- b. Name and contact information for photographer.
- c. Name of Contractor.
- d. Date photograph was taken.
- e. Description of location, vantage point, and direction.
- f. Unique sequential identifier keyed to accompanying key plan.

1.3 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect , andConstruction Manager.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
 - 5. Waterproofing and weather-resistant barriers.
- E. Periodic Construction Photographs: Take photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take [20][50][100]<Insert number> photographs after date of Substantial Completion for submission as Project Record Documents. Architect , andConstruction Manager will inform photographer of desired vantage points.

1.4 CONSTRUCTION WEBCAM

- A. Webcam: Provide two fixed-location camera(s) with weatherproof housing, mounted to provide unobstructed view of construction site from location approved by Architect, with the following characteristics:
 - 1. Static view.
 - 2. Capable of producing minimum 12 megapixel images.
 - 3. Provide pole mount, power supply, **[solar power station,]** active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Live Streaming Images: Provide web-accessible image of current site image, updated at five-minute intervals during daytime operation.
- C. Web-Based Interface: Provide online interface to allow viewing of each high-definition digital still image captured and stored during construction, from the Internet.
 - 1. Access Control: Provide password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
 - 2. Software: Provide responsive software interface for use on computer, tablet, and mobile screens with accompanying iPhone/iPad app and Android apps.
 - 3. Storage: Maintain images on the website for reference during entire construction period, and for not less than 30 days after Final Completion. Provide sufficient memory on remote server to store all Project images.
 - 4. Online Interface: Provide website interface with Project and client information and logos, calendar-based navigation interface for selecting images, and pan and zoom capability within high-definition images.
 - 5. Forward and Reverse: Provide capability to browse through images, moving forward and backward in time by individual image and by day.
 - 6. Slideshow: Provide capability to automatically display current images from sites when there are three or more cameras used.
 - 7. Time-Lapse: Provide capability for online display of project time-lapse.
 - 8. Dashboard: Provide capability to view thumbnails of all cameras on one screen.
 - 9. Weather: Provide corresponding weather data for each image captured.
- D. Maintain cameras and web-based access in good working order, in accordance with web-based construction photographic documentation service provider's written instructions until Final Completion. Provide for service of cameras and related networking devices and software.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013300 SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Construction Manager's final release or approval.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.
 7. Names of subcontractor, manufacturer, and supplier.
 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 9. Category and type of submittal.
 10. Submittal purpose and description.
 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 12. Drawing number and detail references, as appropriate.
 13. Indication of full or partial submittal.
 14. Location(s) where product is to be installed, as appropriate.
 15. Other necessary identification.
 16. Remarks.

17. Signature of transmitter.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's, and receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect, and Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Construction Manager, through Architect, before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect and Construction Manager.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data[**unless submittal based on Architect's digital data drawing files is otherwise permitted**].
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.

- f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 - 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
 - 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 2 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.
 - 8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. [**Mark up and retain one returned Sample set as a project record Sample.**]
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written

summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is

installed in its final location, for compliance with requirements in the Contract Documents.

3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for

coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
1. Architect and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.
 2. Contractor approval shall certify the following actions by the Contractor:
 - a. Field measurements have been determined, verified, and indicated on submittals.
 - b. Field conditions have been verified and coordinated with Work associated with the submittal.
 - c. The work associated with the submittal is in conformance with the Contract Documents.
 - d. Work being performed by various subcontractors and trades is coordinated with Work associated with the submittal including work being performed by others for the Owner.
 - e. Deviations from the Contract Documents are identified and noted.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:
 - a. Reviewed: Final unrestricted release, work may proceed, provided it complies with the Contract Documents..
 - b. Furnish as Corrected: Final but restricted release, work may proceed, provided written confirmation is delivered to Architect by Contractor that installed work complied with notations and corrections on submittal and with Contract Documents.
 - c. Revise and Resubmit: Return for resubmittal, do not proceed with work. Revise submittal in accordance with notations, and resubmit without delay to obtain an acceptable action marking. Do not allow submittals with this marking (or unmarked submittals where a marking is required) to be used in connection with performance of the Work.
 - d. Rejected: Submittal content varies from the Contract Documents and is not acceptable for use on the Project, do not proceed with work. Revise submittal in accordance with notations, and resubmit without delay to obtain an acceptable action marking. Do not allow submittals with this marking (or unmarked submittals where a marking is required) to be used in connection with performance of the Work.

2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

a. Actions taken by indication on Project management software website have the following meanings:

1) Same as pdf actions indicated within this specification section.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

1.10 COST FOR MULTIPLE RESUBMITTALS

A. Contractor's initial submittal and one resubmittal are included in the Architect's Construction Administration services to the Owner. Architect's services for review of subsequent resubmittals will be charged to the Owner at the Architect's current billing rate, and the Owner will deduct the charges from the Contract Amount by a change order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 014000
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
 - 1. Divisions 02 through 33 Sections for specific test and inspection requirements..
- D. The Division of the State Architect Testing and inspection Requirements for School Construction: the following requirements indicated below may be repeated elsewhere in this Section or in other Sections of the Project Manual, where conflicts occur, the most stringent condition shall apply.
 - 1. Per the Division of the State Architect (DSA):
 - a. Test:
 - 1) The owner will select an independent testing laboratory, approved by DSA, to conduct the tests. Selection of the material required to be tests shall be by the laboratory or the Owner's representative and not by the Contractor.
 - 2) The Contractor shall notify the Owner's representative a sufficient time in advance of the manufacture of material to be supplied by him under the Contract Documents, which must by terms of the Contract be tested, in order that the Owner may arrange for the testing of same at the source of supply.
 - 3) Any material shipped by the Contractor from the source of supply prior to having satisfactorily passed such testing and inspection or

prior to the receipt of notice from said representative that such testing and inspection will not be required shall not be incorporated in the job.

- 4) The Owner will pay testing laboratory costs for all tests and inspections, but may be reimbursed by the Contractor for such costs under the Contract documents.

b. Test Reports:

- 1) One copy of all test reports shall be forwarded to the Division of the State Architect by the testing agency. Such reports shall include all the tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations as required shall also be reported. The reports shall show that the material or materials were sampled and tested in accordance with the requirements of Title 24 and with the approved specifications. Test reports shall show the specified design strength. They shall also state defiantly whether or not the material or materials tested comply with requirements.

c. Verification of Test Reports:

- 1) Each testing agency shall submit to the Division of the State Architect a verified report in duplicate covering all the tests which are required to be made by that agency during the progress of the project. Such report shall be furnished each time that work on the project is suspended, covering the tests up to that time, and at the completion of the project, covering all tests.

d. Inspection by the Owner:

- 1) The Owner and his representatives shall at all times have access for the purpose of inspection to all parts of the work and to the shops wherein the work is in preparation, and the Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
- 2) The Owner shall have the right to reject materials and workmanship which are defective, or to require their correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the Owner. If the Contractor does not correct such rejected work within a reasonable time, fixed by written notice, the Owner may correct same and charge expense to the Contractor.
- 3) Should it be considered necessary or advisable by the Owner at any time before final acceptance of the entire work to make an examination of the work already completed by removing or tearing out the same, the Contractor shall on request promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any respect due to the fault of the Contractor or his subcontractor, he shall defray all expenses of such examinations and

of satisfactory reconstruction. If however, such work is found to meet the requirements of the Contract, the additional cost of labor and material necessarily involved in the examination and replacement shall be allowed the Contractor.

e. Owner's Project Inspector:

- 1) A Project Inspector employed by the Owner, and approved by DSA, in accordance with the requirements of the California Code of Regulations, Title 24 will be assigned to the work. The Project Inspector's duties are defined in Title 24, Part I, Sec. 4-342.
- 2) The work of construction in all stages of progress shall be subject to the personal continuous observation of the Project Inspector. The Project Inspector shall have free access to any or all parts of the work at any time. The Contractor shall furnish the Project Inspector reasonable facilities for obtaining such information as may be necessary to keep the Project Inspector fully informed respecting the progress and manner of the work and the character of materials. Inspection of the work shall not relieve the Contractor from any obligation to fulfill this contract.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

- F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.3 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 PROJECT INSPECTOR

- A. General: Owner will employ a Project Inspector for continuous inspection of the Work. Project Inspector shall be acceptable to Architect and approved by the Division of the State Architect.
 - 1. Project Inspector shall act under the direction of the Architect and shall be subject to supervision by a representative of the Division of the State Architect.

- B. Qualifications for Project Inspector: Qualifications for the Project Inspector shall be as stated in the California Code of Regulations, Title 24, Part 1, California Administrative Code, Section 4-333.1. Project Inspector shall be DSA certified under one of the following classes:
1. Class 1: May inspect any project, including complex structures with steel, masonry, or concrete.
 2. Class 2: May inspect any project except those with steel, masonry, or concrete primary lateral force-resisting systems.
 3. Class 3: May inspect alterations to approved buildings, site placement of relocatable buildings, and minor structure.
 4. Class 4: May inspect the site placement of relocatable buildings and associated site work.
- C. Duties of the Project Inspector: Duties of the Project Inspector shall be as stated in the California Code of Regulations, Title 24, Part 1, California Administrative Code, Sections 4-333(b) and 4-342, and include the following:
1. Provide continuous inspection of the work.
 2. Maintain files and records of approved plans and specifications including addenda and change orders.
 3. Prepare semi-monthly reports of the progress of the work and submit copies to the Architect and the Division of the State Architect.
 4. Notify the Division of the State Architect at the following times:
 - a. At the start of construction of the project or restart of construction if work has suspended for a period of 2 or more weeks.
 - b. At least 48 hours in advance of the time when foundation trenches will be complete, ready for footing forms.
 - c. At least 48 hours in advance of the first placement of foundation concrete and 24 hours in advance of any subsequent or significant concrete placement.
 - d. When all work on the project has been suspended for a period of more than 2 weeks.
 5. Prepare and maintain records of certain phases of construction including but not limited to the following:
 - a. Concrete placing operations. Show date and time of placing concrete and the time and date of removal of forms in each portion of the structure.
 - b. Welding operations. The record shall include identification marks of welders, lists of defective welds, and manner of correction of defects.
 6. Notify the Contractor, in writing, of any deviations from the approved construction documents.
 7. Prepare and submit Project Inspector's Verified Report as required by DSA.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to

Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
 - 2. **<Insert qualifications appropriate to Project>.**
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 - 3. Owner-performed tests and inspections indicated in the Contract Documents[, **including tests and inspections indicated to be performed by Commissioning Authority**].
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Governing Agency Verified Reports: Complete and submit Verified Reports as required by the Division of the State Architect and the California Administrative Code, Section 4-336. Reports are required to be completed by Architect, Architect's consulting Engineers, Owner's Project Inspector, Contractor, and Testing Agency.
 - 1. DSA Form:

- a. DSA-6C; Contractor Required.
 - b. DSA-6PI; Project Inspector Required.
 - c. DSA-6A/E; Architect and Architects consulting Engineers Required.
- B. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- C. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, telephone number, and email address of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement of whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- D. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 - 2. Statement that equipment complies with requirements.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 4. Statement of whether conditions, products, and installation will affect warranty.
 - 5. Other required items indicated in individual Specification Sections.

- E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.10 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 72 hours in advance of time when Work that requires testing or inspection will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- C. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform duties of Contractor.

- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency , and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager, with copy to

- Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's authorities' having jurisdiction reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 014200 REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of

standards as listed in building codes.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

- B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.

19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; [**American Society of Mechanical Engineers (The)**]; www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BSI - British Standards Institution; www.bsigroup.com.
50. BWF - Badminton World Federation; www.bwfbadminton.com.
51. CARB - California Air Resources Board; www.arb.ca.gov.
52. CDA - Copper Development Association Inc.; www.copper.org.
53. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
54. CEA - Canadian Electricity Association; www.electricity.ca.
55. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
56. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
57. CGA - Compressed Gas Association; www.cganet.com.
58. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.

59. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
60. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
61. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
62. CMHA - Concrete Masonry & Hardscape Association; (Formerly: National Concrete Masonry Association); www.masonryandhardscapes.org.
63. CPA - Composite Panel Association; www.compositepanel.org.
64. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
65. CRRC - Cool Roof Rating Council; www.coolroofs.org.
66. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
67. CSA - CSA Group; www.csagroup.org.
68. CSI - Cast Stone Institute; www.caststone.org.
69. CSI - Construction Specifications Institute (The); www.csiresources.org.
70. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
71. CTA - Consumer Technology Association; www.cta.tech.
72. CTI - Cooling Technology Institute; www.coolingtechnology.org.
73. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
74. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
75. DHI - Door and Hardware Institute; www.dhi.org.
76. ECIA - Electronic Components Industry Association; www.ecianow.org.
77. EIMA - EIFS Industry Members Association; www.eima.com.
78. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
79. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
80. ESTA - Entertainment Services and Technology Association; www.esta.org.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
84. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
85. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
87. FM Global - FM Global; www.fmglobal.com.
88. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridarroof.com.
89. FSA - Fluid Sealing Association; www.fluidsealing.com.
90. FSC - Forest Stewardship Council U.S.; www.fscus.org.
91. GA - Gypsum Association; www.gypsum.org.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
95. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
96. IAS - International Accreditation Service; www.iasonline.org.
97. ICC - International Code Council; www.iccsafe.org.
98. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
99. ICPA - International Cast Polymer Association (The); www.theicpa.com.
100. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
101. IEC - International Electrotechnical Commission; www.iec.ch.
102. IEEE SA - IEEE Standards Association; <https://standards.ieee.org>.

103. IES - Illuminating Engineering Society; www.ies.org.
104. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
105. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
106. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
107. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
108. Intertek - Intertek Group; www.intertek.com.
109. ISA - International Society of Automation (The); www.isa.org.
110. ISFA - International Surface Fabricators Association; www.isfanow.org.
111. ISO - International Organization for Standardization; www.iso.org.
112. ITU - International Telecommunication Union; www.itu.int.
113. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
114. LPI - Lightning Protection Institute; www.lightning.org.
115. MBMA - Metal Building Manufacturers Association; www.mbma.com.
116. MCA - Metal Construction Association; www.metalconstruction.org.
117. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
118. MFMA - Metal Framing Manufacturers Association, Inc.;
www.metalframingmfg.org.
119. MHI - Material Handling Industry; www.mhi.org.
120. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
121. MPI - Master Painters Institute; www.paintinfo.com.
122. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry,
Inc.; www.msshq.org.
123. NAAMM - National Association of Architectural Metal Manufacturers;
www.naamm.org.
124. NACE - NACE International; (National Association of Corrosion Engineers
International); (see AMPP).
125. NADCA - National Air Duct Cleaners Association; www.nadca.com.
126. NAIMA - North American Insulation Manufacturers Association;
www.insulationinstitute.org.
127. NALP - National Association of Landscape Professionals;
www.landscapeprofessionals.org.
128. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
129. NBI - New Buildings Institute; www.newbuildings.org.
130. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
131. NCMA - National Concrete Masonry Association; (see CMHA).
132. NEBB - National Environmental Balancing Bureau; www.nebb.org.
133. NECA - National Electrical Contractors Association; www.necanet.org.
134. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
135. NEMA - National Electrical Manufacturers Association; www.nema.org.
136. NETA - InterNational Electrical Testing Association; www.netaworld.org.
137. NFHS - National Federation of State High School Associations; www.nfhs.org.
138. NFPA - National Fire Protection Association; www.nfpa.org.
139. NFPA - NFPA International; (see NFPA).
140. NFRC - National Fenestration Rating Council; www.nfrc.org.
141. NGA - National Glass Association; www.glass.org.
142. NHLA - National Hardwood Lumber Association; www.nhla.com.
143. NLGA - National Lumber Grades Authority; www.nlga.org.
144. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
145. NOMMA - National Ornamental & Miscellaneous Metals Association;
www.nomma.org.
146. NRCA - National Roofing Contractors Association; www.nrca.net.

147. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
148. NSF - NSF International; www.nsf.org.
149. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
150. NSPE - National Society of Professional Engineers; www.nspe.org.
151. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
152. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
153. NWFA - National Wood Flooring Association; www.nwfa.org.
154. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
155. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
156. PDI - Plumbing & Drainage Institute; www.pdionline.org.
157. PLASA - PLASA; www.plasa.org.
158. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
159. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
160. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
161. RFCI - Resilient Floor Covering Institute; www.rfci.com.
162. RIS - Redwood Inspection Service; (see WWPA).
163. SAE - SAE International; www.sae.org.
164. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
165. SDI - Steel Deck Institute; www.sdi.org.
166. SDI - Steel Door Institute; www.steeldoor.org.
167. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
168. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
169. SIA - Security Industry Association; www.securityindustry.org.
170. SJI - Steel Joist Institute; www.steeljoist.org.
171. SMA - Screen Manufacturers Association; www.smainfo.org.
172. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
173. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
174. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
175. SPIB - Southern Pine Inspection Bureau; www.spib.org.
176. SPRI - Single Ply Roofing Industry; www.spri.org.
177. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
178. SSINA - Specialty Steel Industry of North America; www.ssina.com.
179. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
180. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
181. SWI - Steel Window Institute; www.steelwindows.com.
182. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
183. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
184. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
185. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
186. TIA - Telecommunications Industry Association; www.tiaonline.org.
187. TMS - The Masonry Society; www.masonrysociety.org.
188. TPI - Truss Plate Institute; www.tpinst.org.
189. TPI - Turfgrass Producers International; www.turfgrasssod.org.
190. TRI - Tile Roofing Industry Alliance; www.tilerroofing.org.
191. ULSE - UL Standards & Engagement Inc.; www.ulse.org.
192. UL - UL Solutions Inc.; www.ul.com.

193. USAV - USA Volleyball; www.usavolleyball.org.
194. USGBC - U.S. Green Building Council; www.usgbc.org.
195. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
196. WA - Wallcoverings Association; www.wallcoverings.org.
197. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
198. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
199. WDMA - Window & Door Manufacturers Association; www.wdma.com.
200. WI - Woodwork Institute; www.woodworkinstitute.com.
201. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
202. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov.
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from U.S. General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specifications and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; <https://tfsweb.tamu.edu/>.
8. DSA; Division of the State Architect.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 011200 "Multiple Contract Summary" for responsibilities for temporary facilities and controls for projects utilizing multiple contracts.
 - 3. Section 012100 "Allowances" for allowance for metered use of temporary utilities.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- G. Sewer, Water, and Electric Power Service: Use charges are specified in Section 011200 "Multiple Contract Summary."

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.
- G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:
 - 1. Methods used to meet the goals and requirements of Owner.
 - 2. Concrete cutting method(s) to be used.
 - 3. Location of construction devices on the site.
 - 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 - 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.
 - 6. Indicate locations of sensitive student and faculty areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 1-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts[, with 1-5/8-inch- OD top rails.
- B. Portable Chain-Link Fencing: Minimum 1-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.
- C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- D. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- E. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

- A. Field Offices:
 - 1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner,

Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to private system indicated as directed by authorities having jurisdiction.
- C. Water Service:
 - 1. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Electric Power Service:
 - 1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate

illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment one land-based telephone line(s) for each field office.
1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Construction Manager's home office.
 - g. Engineers' offices.
 - h. Owner's office.
 - i. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.

- D. Parking: Provide temporary offsite parking areas for construction personnel.
- E. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs, so they are legible at all times.
- H. Waste Disposal Facilities:
 - 1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- B. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- C. Tree and Plant Protection:
 - 1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully,

using materials approved by authorities having jurisdiction.

- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 4. Section 014200 "References" for applicable industry standards for products specified.
 - 5. Section 017700 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluating Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. [**Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.**]
 - C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
 - D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 2. Data indicating compliance with the requirements specified in "Comparable Products" Article.
 - E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
 - F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.
- 1.3 QUALITY ASSURANCE
- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 1. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products will be used.
 - B. Identification of Products: Except for required labels and operating data, do not attach

or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.

2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections are to be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.

B. Product Selection Procedures:

1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered[**unless otherwise indicated**].
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
2. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
3. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience [**will**][**will not**] be considered[**unless otherwise indicated**].
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
4. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

- a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
- 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those of the

named basis-of-design product. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.

3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

1. Architect's Approval of Submittal: As specified in Division 1Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017300 EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering.
 - 3. Installation.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination of Owner-furnished products , Owner's separate contracts, and limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certified Surveys: Submit two copies signed by land surveyor.
- C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Plumbing piping systems.
 - c. Mechanical systems piping and ducts.
 - d. Control systems.
 - e. Communication systems.
 - f. Fire-detection and -alarm systems.
 - g. Conveying systems.
 - h. Electrical wiring systems.
 - i. Operating systems of special construction.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Construction Manager in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with

control lines and levels. Level foundations and piers from two or more locations.

- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Contractor will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore

surfaces to their original condition.

- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

- a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
 - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
 - 2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.

- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000

"Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

- A. CMU: Concrete masonry units.
- B. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- C. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- D. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- E. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- F. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- G. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work. Plan must include the following:
 1. Strategies to reduce the generation of waste during Project design and construction.
 2. Waste diversion goals for Project, identifying the materials (both structural and nonstructural) targeted for recycling, reuse, or salvage and identifying the target diversion percentage (at least 50 percent).
 3. Where materials will be taken, including expected diversion rates for each material.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use **[Form CWM-7 for construction waste][and][Form CWM-8 for demolition waste]<Insert Owner's form designation>**. Include the following information:
 1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in **tons**.
 4. Quantity of waste salvaged, both estimated and actual in **tons**.
 5. Quantity of waste recycled, both estimated and actual in **tons**.
 6. Total quantity of waste recovered (salvaged plus recycled) in **tons**.
 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
 - 1. Firm employs a LEED Accredited Professional, certified by USGBC, as waste management coordinator.
 - 2. Waste management coordinator may also serve as LEED coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

1.7 REGULATORY REQUIREMENTS

- A. Construction Waste Management: Refer to CGBSC Section 5.408.1 Construction Waste Management. Recycle and/or salvage for reuse a minimum of 65 percent of the non-hazardous construction and demolition waste in accordance with CGBSC Section 5.408.1.1, 5.408.1.2, or 5.408.1.3 (Below) or meet a local construction and demolition waste management ordinance, whichever is more stringent:
 - 1. GBSC Section 5.408.1.1, Construction Waste Management Plan: Where a local jurisdiction does not have a construction and demolition waste management ordinance that is more stringent, provide Waste Management Plan that:
 - a. Identifies the construction and demolition waste materials to be diverted from disposal by efficient usage, recycling, reuse on the project or salvage for future use or sale.
 - b. Determines if construction and demolition waste materials will be sorted on-site (source separated) or bulk mixed (single stream).
 - c. Identifies diversion facilities where construction and demolition waste material collected will be taken.
 - d. Specifies the amount of construction and demolition waste materials diverted shall be calculated by weight or volume, but not by both.
 - 2. GBSC Section 5.408.1.2, Waste Management Company: Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with CGBSC Section 5.408.1.
 - a. Exception 1: Excavated soil and land-clearing debris.
 - b. Exception 2: Alternate waste reduction methods developed by working with local agencies if diversion or recycle facilities capable of compliance with this item do not exist.
 - c. Demolition waste meeting local ordinance or calculated in consideration of local recycling facilities and markets.
 - 3. GBSC Section 5.408.1.3, Waste Stream Reduction Alternative: The combined weight of new construction disposal that does not exceed two pounds per square

foot of building area may be deemed to meet the 65 percent minimum requirement as approved by the enforcing agency.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan in accordance with requirements in this Section. Plan must include provisions for waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work **Form CWM-1 for construction waste** **[and]** **Form CWM-2 for demolition waste** **<Insert Owner's form designation>**. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator **[Form CWM-3 for construction waste]** **[and]** **[Form CWM-4 for demolition waste]** **<Insert Owner's form designation>**. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 024119 "Selective Demolition."
 - 2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
 - 1. Demolition Waste:
 - a. Concrete.

- b. Concrete reinforcing steel.
- c. CMU.
- d. Wood joists.
- e. Structural and miscellaneous steel.
- f. Rough hardware.
- g. Roofing.
- h. Insulation.
- i. Doors and frames.
- j. Door hardware.
- k. Equipment.
- l. Electrical devices.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Metals.
- e. Roofing.
- f. Insulation.
- g. Piping.
- h. Electrical conduit.
- i. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.
- j. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - 1) Paper.
 - 2) Aluminum cans.
 - 3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste

management plan during entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Handle as follows:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale or Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use: Handle as follows:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials to accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials in accordance with recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to maximum extent practical in accordance with approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination, and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 1-1/2-inch size.
- B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Clean and stack undamaged, whole masonry units on wood pallets.
- C. Wood Materials: Sort and stack members per size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- D. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members per size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

- E. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- F. Conduit: Reduce conduit to straight lengths and store by material and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cutoffs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location.
- D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Unless otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning:
 - 1. Do not burn waste materials.

END OF SECTION

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final Completion procedures.
 - 3. List of incomplete items.
 - 4. Submittal of Project warranties.
 - 5. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect, and Construction Manager. Label with manufacturer's name and model number.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit sustainable design submittals not previously submitted.
 - 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."

6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Following inspection, Architect will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected.
1. Architect's Punch List: During inspection, Architect will prepare a list of items needing completion or correction (punch list), a copy of the punch list will be distributed to the Contractor and Owner.
 2. Reinspection: Request reinspection when the Work identified in previous inspection as incomplete is completed or corrected.
 3. Results of completed inspection will form the basis of requirements for final completion.
- E. Contractor's Cost for Reinspection: Architect will perform one inspection and one reinspection at no additional cost to the Contractor. The expense for the Architect's time for additional inspections will be paid by the Owner with the amount being deducted from the Contract Sum. The expense will be based on an hourly rate in accordance with the Architect's standard hourly rate schedule in effect at the time the work is performed with a minimum of \$600.00 dollars for each additional reinspection.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect

will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel Electronic File: Architect, through Construction Manager, will return annotated file.
 - b. PDF Electronic File: Architect, through Construction Manager, will return annotated file.
 - c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit by uploading to web-based project software site , and/or by email to

Architect.

D. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch** paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material

from Project site.

- e. Remove snow and ice to provide safe access to building.
- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
- i. Vacuum and mop concrete.
- j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
- k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- l. Remove labels that are not permanent.
- m. Wipe surfaces of mechanical and electrical equipment[, **elevator equipment,**] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- r. Clean strainers.
- s. Leave Project clean and ready for occupancy.

- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

- A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION

SECTION 017823
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect[**and Commissioning Authority**] will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Architect, through Construction Manager, will return

two copies.

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect, and Construction Manager[**and Commissioning Authority**] will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect[**and Commissioning Authority**] will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's[**and Commissioning Authority's**] comments. Submit copies of each corrected manual within 15 days of receipt of Architect's[**and Commissioning Authority's**] comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold **8-1/2-by-11-inch** paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter

of contents[, and indicate **Specification Section number on bottom of spine**]. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on **8-1/2-by-11-inch** white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual to contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation in accordance with ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.7 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including

- disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
 - E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
 - F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
 - G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 - H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
 - I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
 - J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of maintenance manuals.
- 1.9 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
 - B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair

materials and sources, and warranties and bonds, as described below.

- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017839
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
 - 2. Section 017300 "Execution" for final property survey.
 - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit 2 paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and 2 set(s) of file prints.
 - 3) Submit Record Digital Data Files and one set(s) of plots.
 - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit three paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.
 - c. Final Submittal:

- 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit Record Digital Data Files and three set(s) of Record Digital Data File plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- D. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.

- i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
- 1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
 - 2. Format: DWG, Version 2018 Microsoft Windows operating system.
 - 3. Format: Annotated PDF electronic file with comment function enabled.
 - 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 - 5. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 - 6. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
- 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file with comment function enabled.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:

- a. Project name.
- b. Date.
- c. Designation "PROJECT RECORD DRAWINGS."
- d. Name of Architect and Construction Manager.
- e. Name of Contractor.

1.4 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
 - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.

2. Transcript:
 - a. Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - b. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:

- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 018113
SUSTAINABLE DESIGN REQUIREMENTS - CALGREEN NON-RESIDENTIAL MANDATORY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General requirements and procedures for compliance with and certification from 24 CCR 11 (hereafter, "CALGreen").
 - 1. Some CALGreen requirements depend on product selections and may not be specifically identified as CALGreen requirements. Compliance with CALGreen requirements may be used as one criterion to evaluate substitution requests and comparable product requests.
 - 2. Copies of CALGreen project checklists are attached at the end of this Section for information only. The checklists are for Mandatory Measures, with additional available for the voluntary CALGreen Tier 1 and Tier 2 levels of certification.
 - a. Some CALGreen requirements depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 - 3. Related Sections:
 - a. Project Manual Appendix No. 3, DSA Calgreen Code Submittal Checklist 403-C

1.2 DEFINITIONS

- A. VOCs: Volatile organic compounds.
- B. Composite Wood Products: Hardwood plywood, particleboard, and medium-density fiberboard. Composite wood products do not include hardboard, structural plywood.
- C. Recycled Content: Component of a material made of recycled materials. Recycled material can be derived from two sources: pre-consumer, also known as "post-industrial," or "post-consumer." "Post-consumer recycled material" refers to items, such as aluminum cans, that have been in the consumer market. Post-industrial material is waste generated from the original manufacturing process that is used again.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site. Review CALGreen requirements and action plans for compliance with requirements. Also, reference Section 013100 "Project Management and Coordination" for further information.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect about CALGreen requirements that depend on product selection or product qualities. Document responses as informational submittals.
- B. Environmental Management System: Document the following:
 - 1. Environmental policy.
 - 2. Regulatory compliance and training.
 - 3. Environmental risk assessment that shows sensitive environmental areas and ranks potential risks that may arise from the construction.
 - 4. Environmental risk management strategies.
 - 5. Environmental management roles, responsibilities, and reporting structure for the construction phase.
 - 6. Site and work instructions for site personnel, outlining environmental procedures during construction.
 - 7. Environmental inspection checklists.
 - 8. Records of compliance.

1.5 ACTION SUBMITTALS

- A. General: Submit additional sustainable design submittals required by other Specification Sections.
- B. Sustainable Design Documentation Submittals:
 - 1. Stormwater pollution prevention plan.
 - 2. Product data for irrigation system components, including, but not limited to, the following:
 - a. Sprinkler Heads: Indicate degree of head rotation and spray characteristics/pattern.
 - b. Controllers and sensors.
 - 3. Product data and schedules for plumbing fixtures and fittings. Include rated capacities and WaterSense certification where applicable.
 - 4. Product data for residential appliances, indicating that products are Energy Star rated.
 - 5. Environmental management system documents.
 - 6. Lighting controls.
 - 7. Environmental product declarations.
 - 8. Third-party certifications based on multiple-attribute standards.
 - 9. Third-party-certified life-cycle product assessments.
 - 10. Product data, manufacturer's certifications, chain-of-custody certification, or other documentation acceptable to authorities having jurisdiction; for products containing composite wood, agrifiber products, or wood glues, indicate compliance with California Air Resource Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood."
 - 11. Construction waste management plan complying with Section 017419

- "Construction Waste Management and Disposal."
12. Product data and laboratory test reports for adhesives and sealants indicating VOC content and compliance with requirements for low-emitting materials.
 13. Certificates for carpet and undercarpet adhesives indicating compliance with Carpet and Rug Institute's Green Label Plus testing program.
 14. Product data and laboratory test reports for paints and coatings indicating VOC content and compliance with requirements for low-emitting materials.
 15. Laboratory test reports for hard flooring, insulation, acoustical ceilings, and wall coverings, indicating compliance with requirements for low-emitting materials, as defined in "Low-Emitting Materials" Article.

1.6 INFORMATIONAL SUBMITTALS

- A. Project Materials Cost Data: Submit statement indicating total cost for materials used for the Work. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
 1. Plumbing.
 2. Mechanical.
 3. Electrical.
 4. Specialty items, such as elevators and equipment.
 5. Wood-based construction materials.
- B. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with sustainable design action plans.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide products and procedures necessary to comply with CALGreen requirements referenced in the Evaluations. Although other Sections may specify some requirements that contribute to referenced CALGreen requirements, determine additional materials and procedures necessary to comply with CALGreen requirements indicated.

2.2 LOW-EMITTING MATERIALS

- A. Adhesives and Sealants:
 1. For field applications inside the building, adhesives and sealants shall comply with the following VOC content limits:
 - a. Wood Glues: 30 g/L.
 - b. Metal-to-Metal Adhesives: 30 g/L.
 - c. Adhesives for Porous Materials (except Wood): 50 g/L.
 - d. Subfloor Adhesives: 50 g/L.

- e. Plastic Foam Adhesives: 50 g/L.
 - f. Carpet Adhesives: 50 g/L.
 - g. Carpet Pad Adhesives: 50 g/L.
 - h. VCT and Asphalt Tile Adhesives: 50 g/L.
 - i. Cove Base Adhesives: 50 g/L.
 - j. Gypsum Board and Panel Adhesives: 50 g/L.
 - k. Rubber Floor Adhesives: 60 g/L.
 - l. Ceramic Tile Adhesives: 65 g/L.
 - m. Multipurpose Construction Adhesives: 70 g/L.
 - n. Fiberglass Adhesives: 80 g/L.
 - o. Contact Adhesive: 80 g/L.
 - p. Structural Glazing Adhesives: 100 g/L.
 - q. Wood Flooring Adhesive: 100 g/L.
 - r. Single-Ply Roof Membrane Adhesive: 250 g/L.
 - s. Special-Purpose Contact Adhesive (Contact Adhesive That Is Used to Bond Melamine Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
 - t. Plastic Cement Welding Compounds: 250 g/L.
 - u. ABS Welding Compounds: 325 g/L.
 - v. CPVC Welding Compounds: 490 g/L.
 - w. PVC Welding Compounds: 510 g/L.
 - x. Adhesive Primer for Plastic: 550 g/L.
 - y. Architectural Sealants: 250 g/L.
 - z. Nonmembrane Roof Sealants: 300 g/L.
 - aa. Single-Ply Roof Membrane Sealants: 450 g/L.
 - bb. Other Sealants: 420 g/L.
2. For field applications inside the building, adhesives and sealants must comply with the requirements of SCAQMD Rule 1168 or local code when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Carpet, cushion, and undercarpet adhesives will comply with CRI's Green Label Plus testing program.
- C. Paints: For field applications inside the building, wall paints must comply with local code requirements when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Resilient Flooring: Flooring must be certified by the Resilient Floor Covering Institute and/or be compliant when tested in accordance with the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Flooring must also comply with the Collaborative for High Performance Schools (CHPS) requirements.
- E. Thermal Insulation: Provide insulation complying with CALGreen Tier 1 or 2 requirements.

- F. Ceiling and Wall Panels: Acoustical ceiling and wall-cladding products must comply with the VOC emissions limits defined in the CHPS criteria and be listed in the CHPS Pre-Approved Products database or have a Greenguard Certification Program.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

- A. CALGreen requires use of a construction waste management plan outlining how waste will be divided on the construction site, as well as how often it will be hauled to a landfill or recycling center and by whom.
- B. CALGreen includes a sample plan outlining all specific requirements of the plan.
- C. Comply with Section 017419 "Construction Waste Management and Disposal."

3.2 INDOOR-AIR-QUALITY ASSESSMENT

- A. Air-Quality Testing:
 - 1. Conduct baseline IAQ testing, after substantial completion of construction and prior to occupancy, in accordance with the EPA's "Testing for Indoor Air Quality - Section 01 81 09."
 - 2. Verify compliance with standards and limits in the EPA's "Testing for Indoor Air Quality - Section 01 81 09."
 - a. Carbon monoxide maximum is 9 ppm, not to exceed outdoor levels by 2 ppm.
 - b. Formaldehyde maximum is 27 ppb.
 - c. Particulates maximum is 50 micrograms per cubic meter.
 - d. 4-Phenylcycohexene maximum is 6.5 micrograms per cubic meter.
 - e. Total VOC maximum is 300 micrograms per cubic meter.
 - 3. If noncompliant test results occur, provide a written report describing source(s) of noncompliant condition(s) and corrective action(s) implemented.

END OF SECTION

SECTION 023000
SUBSURFACE INVESTIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes information for the Geotechnical Investigation Report prepared for this Project.
- B. Related Sections:
 - 1. Division 31 Sections as applicable to site clearing, earthwork, excavations, fill, trenching, and paving.

1.3 GEOTECHNICAL REPORT

- A. A Geotechnical report for this project has been prepared by:

Technicon Engineering Services
4539 N. Brawley Ave., Suite 108
Fresno, CA 93722
(559) 276-9311

Report reference and date of report: TES No. 240282.001 Date: 06/12/2024

- B. A copy of the Geotechnical Investigation Report is contained in the Appendix of this Project Manual.
- C. The Geotechnical Investigation Report shall be considered to be a part of the Contract Documents. The Contractor shall become familiar and comply with the requirements and recommendations in the Report.
- D. The Geotechnical Investigation Report identifies subsurface soil and ground water conditions and offers recommendations for earthwork and preparation of subsurface conditions for the Work of this Project.
- E. The Geotechnical Investigation Report is not a warranty of subsurface conditions. Should subsurface conditions be found to vary substantially from the Report, changes in design and construction of foundations may be made by the Architect, with resulting credits or expenditures to the Contract sum accruing to the Owner.

1.4 QUALITY ASSURANCE

- A. A soil engineer will be retained by the Owner to observe performance of work in connection with excavating, trenching, filling, backfilling, and grading, and to perform compaction tests.
 - 1. Requirements for Field Quality Control are included in individual Sections as applicable to excavating, trenching, filling, backfilling, and grading.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 024119
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 INFORMATIONAL SUBMITTALS

- A. Survey of Existing Conditions: Submit survey.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

- A. Owner will **[not]** occupy portions of site immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials:
 - 1. It is not expected that hazardous materials will be encountered in the Work.
 - a. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- C. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video[, **measured drawings**][and][**templates**]. Comply with Section 013233 "Photographic Documentation."
 - 1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
 - 2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

- A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be

removed to a suitable, protected storage location[**and cleaned**] and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

- A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
 - 3. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.
 - 4. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.
 - a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - b. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining

- construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least **<Insert number>** hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete:
1. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent

- surfaces and areas.
- 3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing to Remain: As indicated on drawings.

END OF SECTION

SECTION 031000
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Formwork for cast-in-place concrete, with shoring, reshoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.3 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 05 12 00 - Structural Steel Framing.

1.4 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Concrete Construction.
 - 3. ACI 303R - Guide to Cast-In-Place Architectural Concrete Practice.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
 - 5. ACI 347R - Guide to Formwork for Concrete.
 - 6. ACI 347.2R - Guide for Shoring/Reshoring of Concrete Multi-story Buildings.

1.5 SUBMITTALS

- A. See Division 01 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data and installation requirements for the following:
 - 1. Tie rods and spreaders.
 - 2. Formwork for exposed concrete.
 - 3. Form coatings and release agents.
- C. Shop Drawings:
 - 1. Formwork Drawings: Formwork drawings, prepared under the supervision of and sealed by the formwork design engineer, shall be submitted for Owner's record only and will not be reviewed or returned.
 - 2. Shoring Drawings and Calculations: Shoring (falsework) drawings and calculations, including shoring, shoring removal, and reshoring plans, prepared under the supervision of and sealed by the contractor's shoring design engineer, shall be submitted for Owner's record only and will not be reviewed or returned. Shoring design, construction, and removal is part of means and methods and is the responsibility of the contractor. Design shall comply with ACI 347.2R and, at a minimum, with jurisdictional and OSHA requirements.

1.6 QUALITY ASSURANCE

- A. Perform work of this section in accordance with all requirements of ACI 347R and ACI 318 Chapter 26.
- B. Delegated Designer Qualifications: Design formwork and shoring under direct supervision of a Professional Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.
- C. Concrete formwork and shores shall be designed and constructed to safely support fluid concrete and superimposed construction loads without excessive deflection or concrete leakage. Provide bracing to maintain accurate alignment and to resist all anticipated lateral loads. Forms shall conform with drawings as to shape, line, and dimension. Design, engineering, and construction of forms, shoring, and reshoring shall be the Contractor's responsibility. The Contractor shall also be responsible for determining when temporary supports, shores, reshores, backshores and other bracing may be safely removed.
- D. Formwork for exposed concrete shall be constructed to the tolerances specified in ACI 303R.
- E. Cooperate and coordinate with other trades who furnish and/or install piping, conduit, reglets, anchors, inserts, sleeves, hangers, etc., as their work requires, including provisions for recesses and chases.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

- C. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.
- D. Protect plastic foam products from damage and exposure to sunlight.

PART 2 - PRODUCTS

2.1 FORMWORK – GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls, unless otherwise noted.
- D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- E. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.
- F. Use the following form types:
 - 1. Concrete not exposed to view: APA Plyform, steel, or clean and sound 1x8 sawn lumber.
 - 2. Smooth Concrete exposed to view: APA Plyform or steel
 - 3. Fiber Forms: Tubular column type spirally constructed of laminated plies of fiber
 - 4. Elevated Floor/Roof Slabs: At discretion of the Contractor.
 - 5. Extruded Polystyrene Foam: board or shaped as required.
 - 6. Form types for concrete exposed to view shall be submitted to and reviewed by the Architect.

2.2 WOOD FORM MATERIALS

- A. Plywood: 5/8-inch minimum APA Plyform.
- B. Lumber: Douglas-Fir species; Standard grade; with grade stamp clearly visible.

2.3 FIBER FORMS

- A. Manufacturers:
 - 1. Sonoco Products Company, Sonotube.
 - 2. Burke Company, Burke Smoothtube.
 - 3. Substitutions: See Division 01 – Product Requirements.
- B. Material shall be of round, spirally wound laminated fiber using a non-water sensitive adhesive and surface wax impregnated for moisture protection, surface treated with

release agent, non-reusable, of sizes indicated. Forms shall give a smooth and seamless appearance to the cast concrete. Provide reveals as shown on the Drawings.

2.4 EXTRUDED POLYSTYRENE FOAM FORMWORK

- A. Manufacturers: Comply with ASTM C578 type IV
 - 1. Dow Chemical Corp., Styrofoam.
 - 2. UC Industries, Foamular.
 - 3. Substitutions: See Division 01 – Product Requirements.

2.5 FORMWORK ACCESSORIES

- A. Form Ties:
 - 1. Concrete exposed to view: Snap ties allowing full 1-inch back break.
 - 2. Concrete not exposed to view: Snap ties or wire.
 - 3. Verify special spacing requirements with architectural drawings at exposed concrete.
- B. Form Clamps:
 - 1. Assembly to have cone washers allowing full 1-inch back break; 3/8" center rod.
- C. Spreaders: metal (no wood)
- D. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 - 1. Do not use materials containing diesel oil or petroleum-based compounds. Form coating containing mineral oils or other non-drying materials will not be permitted for any concrete work.
 - 2. Composition: Colorless, reactive, water-based compound.
 - 3. Products:
 - a. Kaufman Products Inc., FormKote Emulsion.
 - b. Nox-Crete Inc., BIO-NOX.
 - c. SpecChem, LLC, Bio Strip WB (water-based).
 - d. W. R. Meadows, Inc., Duogard II (water-based).
 - e. Substitutions: See Division 01 – Product Requirements.
- E. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.
 - 1. Manufacturers:
 - a. BoMetals, Inc.
 - b. Substitutions: See Division 01 – Product Requirements.

- F. Filler Strips for Chamfered Corners: Rigid plastic or wood type; $\frac{3}{4}$ x $\frac{3}{4}$ inch size unless noted otherwise on the Drawings.
- G. Joint tape: Plastic film tape 3 inches wide.
 - 1. Manufacturers:
 - a. 3M Company, No. 471 plastic film tape.
- H. Expansion Joint Filler (preformed): $\frac{1}{2}$ " thick
 - 1. Manufacturers:
 - a. W.R. Meadows, Inc., Sealtight Fiber Expansion Joint.
- I. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- J. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 12 00.
- K. Waterstops:
 - 1. Configuration: As indicated on the Drawings.
 - 2. Size: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions and elevations agree with drawings.

3.2 EARTH FORMS

- A. Earth forms are not permitted, except as specifically indicated on approved drawings and as indicated below.
 - 1. Concrete footings may be poured directly against cut earth where excavations are deemed stable by a representative of the geotechnical engineer.
 - 2. See Structural drawings for requirements for placing concrete footings directly against earth without forms.
- B. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.3 ERECTION – FORMWORK

- A. Erect and maintain formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

- B. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, locations, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of concrete.
- C. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads. Ensure forms are tied, clamped, and braced to prevent spreading, shifting, or settling.
- D. 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.
- E. Install permanent insulated foam panel formwork per manufacturer's recommendations.
- F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- G. Align joints and make water-tight. Keep form joints to a minimum.
- H. Obtain approval before framing openings in structural members that are not indicated on drawings.
- I. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- J. Coordinate this section with other sections of work that require attachment of components to formwork.
- K. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.4 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 CONSTRUCTION JOINTS

- A. Refer to Specification 03 30 00.

3.6 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete. All such items shall be secured into position before the concrete is placed.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
 - 1. The Contractor shall ensure that sleeves have been installed and other provisions have been made for the installation of mechanical, electrical and other equipment.
 - 2. Coordinate with all trades to ensure proper placement of all items in forms and to provide proper blockouts wherever required.
- D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals as required for the specified product.
- E. Install accessories in accordance with manufacturer's instructions so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are water-tight.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels flush with inside face of forms and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.7 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean and protect permanent foam panel formwork per manufacturer's recommendations.
- C. Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 - 2. No wooden ties or blocking shall be left in concrete except where indicated for attachment of other work.

3.8 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

- B. Construct permanent insulated foam panel formwork to maintain tolerances required by ACI 301.
- C. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.
- D. Camber slabs and beams in accordance with ACI 301.
- E. The Owner shall hire an independent qualified surveyor to verify the proper form, line, position, and elevation of the finished concrete work. The results of each survey shall be sent to the Owner, Architect, Engineer of Record, and Contractor and shall identify any deviation from specified tolerances. All work not in conformance with specified tolerances shall be removed at the Contractor's sole expense if so specified by the Owner.

3.9 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Division 01 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
 - 1. Notify the Architect at least 48 hours in advance of the beginning of pouring operations and at the completion of formwork and location of all construction joints. An inspection of forms and joints will be made for approval of finished work and general layout only. The foregoing inspection shall in no way relieve the Contractor of responsibility of design and safety of formwork, bulkheads and shoring.
 - a. Concrete work out of alignment, level or plumb will be cause for rejection of the whole work affected and, if so rejected, such work shall be removed and replaced, as directed by Architect, with no additional cost to the Owner.
- C. Thoroughly clean and patch all holes in formwork and re-coat as required before reusing. Forms not suited to obtain concrete surfaces and tolerances in conformity with Contract requirements will be rejected by Architect.
 - 1. Reuse of forming materials shall be limited only as required to produce the finishes as specified, free from blemishes and other defects unless covered by other building materials in which case blemish free concrete is not required.

3.10 SHORES AND RESHORES

- A. Comply with ACI 318, ACI 347.2R, and ACI 301 for design, installation, and removal of shoring and reshoring.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively

loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.11 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
 - 1. Formwork and shoring shall remain in place until concrete has cured sufficiently to avoid damage during form removal. The Contractor or their representative in charge of concrete construction shall be present during removal of forms and shores and shall be personally responsible for safety of this operation at all times and under all conditions.
 - 2. Shores must be immediately replaced with reshores in a sequence designed to avoid inducing stress in the concrete member.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.
- D. Surfaces to be painted shall be smooth and free of substances such as dirt, wax, excessive laitance, grease or materials that would prevent proper bonding of finishes.
 - 1. Removal of foregoing contaminants and complete removal of parting and curing compounds affecting proper paint bond, shall be responsibility of this Section of Work. Sandblast cleaning shall not be employed without specific approval of Structural Engineer.
- E. Upon completion of this Work, clean up and remove from Site all equipment and debris resulting from this work.

END OF SECTION

SECTION 032000
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete and/or concrete unit masonry.
- B. Supports and accessories for steel reinforcement.

1.3 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 04 22 00 – Concrete Unit Masonry.
- D. Section 31 63 29 - Drilled Concrete Piers and Shafts: Reinforcement for drilled pier foundations.

1.4 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials
 - 2. ACI 301 - Specifications for Concrete Construction.
 - 3. ACI 315R - Guide to Presenting Reinforcing Steel Design Details.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
 - 5. ACI SP-66 - ACI Detailing Manual.
 - 6. ASTM A82 - Cold Drawn Wire for Concrete Reinforcement.
 - 7. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 8. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 9. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.

10. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
11. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
12. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
13. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
14. ASTM A1035 - Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement.
15. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
16. ASTM D3963 - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
17. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
18. AWS D1.4 - Structural Welding Code - Steel Reinforcing Bars.
19. CRSI (DA4) - Manual of Standard Practice.
20. CRSI (P1) - Placing Reinforcing Bars.
21. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.5 SUBMITTALS

- A. See Division 01 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Prepare in accordance ACI 315 and ACI SP-66 and CRSI standards. Indicate bending diagrams, assembly diagrams, splicing and laps of bars and shapes, dimensions and details of bar reinforcing and assemblies.
 1. The correctness of all reinforcing requirements and work is the responsibility of the Contractor.
 - a. Identify such shop drawings with reference thereon to sheet and detail numbers from Contract Drawings.
 - b. Direct copies of the contract documents are not acceptable as a submission from the Contractor.
 - c. Do not use scaled dimensions from Contract Drawings in determining the lengths of reinforcing bars.
 - d. No reinforcing steel shall be fabricated without approved shop drawings.
 - e. Any deviations from the contract documents must be clearly indicated as a deviation on the shop drawings.
 - f. 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. Include any welding to be done.
 - g. Shop drawings shall make it clear where each bar is located. Beams, grade beams and walls shall be shown in elevation. On elevations show locations of sleeves and penetrations.
 - h. Check architectural, structural, mechanical, and electrical and other contract documents for anchor bolt schedules and locations, anchors, inserts, conduits, sleeves, and any other items which are required to be cast in concrete, and make necessary provisions as required so that

reinforcing steel will not interfere with the placement of such embedded items.

- i. Show all areas of congestion. Identify where reinforcing steel will interfere with the placement of embedded items such as anchor bolts, anchors, inserts, conduits, sleeves and any other items which are required to be cast in concrete.
 - C. Submit shop drawings indicating which members will use fusion welding process for assembly. Shop drawings shall show complete structural details indicating the size of stirrups, the size of holding wires, and welding requirements.
 - D. Submit International Code Council (ICC) Evaluation Service Reports indicating approval from ICC Evaluation Service, Inc. for mechanical splices, hooked anchorage systems, large-headed stud punching shear reinforcement and dowel bar replacement systems.
 - E. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
 1. Reinforcing Bars
 2. Welded Wire Fabric
 3. Welding Electrodes
 4. Fiber Reinforcement
 - F. Product Data:
 1. Manufacturer's specifications and installation instructions for splice devices.
 2. Bar Supports.
 - G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.
 - H. Reports: Submit certified copies of mill test report of reinforcement material chemical and physical analysis.
 1. Tensile and bend tests shall be performed by the mill in accordance with ASTM A615 or A706, as applicable to reinforcing type.
 - I. Samples: Only as required by Architect.
- 1.6 QUALITY ASSURANCE
- A. Perform work of this section in accordance with ACI 301.
 1. Maintain one copy of each document on project site.
 - B. Tests and Inspections:

1. Provide Architect and Special Inspection Agency with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.
2. A testing program is required prior to the start of construction. Testing program to be done in compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
3. All reinforcing steel whose properties are not identifiable by mill test reports shall be tested in accordance with ASTM A615. One Series of tests for each missing report to be borne by the Contractor.
4. When inspections are indicated for reinforcement placement on the Structural drawings, a special inspector shall be employed to inspect reinforcing placement per CBC Chapter 17.
5. When tests are indicated for reinforcing steel on the structural drawings, the reinforcing steel used shall be tested in accordance with ASTM A615. One tensile and one bend test for each 2-1/2 tons of steel or fraction thereof, shall be made.
6. Inspect shop and field welding in accordance with AWS D1.4, including checking materials, equipment, procedure, and welder qualification as well as the welds. Inspector will use non-destructive testing or any other non-destructive aid to visual inspection that Inspector deems necessary to assure the adequacy of the weld.
7. Tests and inspection shall be performed by Owners testing agency except when needed to justify rejected work, in which case the cost of retests and reinspection shall be paid by the Owner and back-charged to the Contractor.

C. Installer Qualifications:

1. Reinforcing Steel: Installation shall be done only by an installation firm normally engaged in this business. All work shall be performed by qualified mechanics working under an experienced supervisor.

D. Manufacturer Qualifications:

Reinforcing Steel: A firm regularly engaged in the manufacture of steel bar and welded wire fabric reinforcing.

E. Mechanical Bar Couplers shall have a current ICC-ES or IAPMO Evaluation Report that indicates compliance with the requirements of these specifications.

F. Steel Reinforcing Allowable Tolerance (ACI 117):

1. Fabrication:
 - a. Sheared length: 1 inch.
 - b. Depth of truss bars: Plus or minus 1/2-inch.
 - c. Ties: Plus or minus 1/2-inch.
 - d. All other bends: Plus or minus 1 inch.
2. Placement:

- a. Concrete cover to form surfaces: Plus or minus ¼-inch.
 - b. Minimum spacing between bars: Plus or minus ¼-inch.
 - c. Crosswise of members: Spaced evenly within 2 inches of stated separation.
 - d. Lengthwise of members: Plus or minus 2 inches.
- 3. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 2 bar diameters.
- G. Unidentifiable Reinforcing Steel: Tested by testing agency; paid for by Contractor:
 - 1. Test reinforcing delivered to site which cannot be properly identified by heat number and mill mark for compliance with ASTM A615 as follows:
 - a. No. 8 Bar and Smaller: One tensile test and one bend test of each size per 7-1/2 tons, or portion thereof.
 - b. No. 9 Bar and Larger: One tensile test of each size per 10 tons, or portion thereof.
- H. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 1. Welders whose work fails to pass inspection shall be requalified before performing further welding.
 - 2. Firm specializing in furnishing and installing reinforcement shall have a minimum of 5 years' experience on projects with requirements similar to this project and shall have sufficient production capacity.
 - 3. All welding shall be performed by operators who are qualified for the types of welds used. Each operator shall have been qualified within the preceding one year as prescribed by AWS.
 - 4. Require welders to retake the qualification test if, as determined by the Architect, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, they shall not perform any welding on the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement

- 1. Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement where occur.
- 2. Deliver reinforcing to Site properly bundled and tagged. Use tags that indicate bar size, lengths and marks corresponding to markings shown on shop drawings. Bundles shall be identified as to heat number and manufacturer and be accompanied by mill and analysis test reports and affidavit from the supplier stating that the material conforms to the requirements of the ASTM specification listed therein. Segregate to maintain identification after bundles are broken.
- 3. Store reinforcement in a manner that will prevent excessive rusting or fouling with/ grease, oil, dirt, and other bond weakening materials.
- 4. Do not use damaged, reworked, or deteriorated material.

- B. Deliver and store welding electrodes in accordance with AWS D1.4.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, deformed grade 60 (60,000 psi) for all bars unless otherwise indicated.
 - 1. Unfinished.
- B. Reinforcing Steel: ASTM A706, deformed low-alloy steel bars for bars to be welded.
 - 1. Unfinished.
- C. Reinforcing Steel: Dual grade ASTM A615/A706, deformed grade 60 (60,000 psi) may be used in lieu of A615 or A706, Grade 60 (60,000 psi).
 - 1. Unfinished.
- D. Reinforcing Steel: ASTM A706, Grade 60 (60,000 psi) for bars used in special seismic systems as indicated in drawings.
 - 1. Unfinished.
 - 2. ASTM A615 Grade 60 bars meeting the following requirements of ACI 318 may be used in lieu of A706 Grade 60 in special seismic systems.
 - a. Actual yield strength based on mill tests does not exceed more than 78,000 psi.
 - b. Minimum tensile strength based on mill tests is 80,000 psi.
 - c. The ratio of the actual tensile strength to the actual yield strength is at least 1.10.
 - d. Minimum fracture elongation in 8 in. shall be at least 14% for bar sizes #3 through #6, at least 12% for bar sizes #7 through #11, and at least 10% for bar sizes #14 and #18.
- E. Minimum uniform elongation shall be at least 9% for bar sizes #3 through #10, and at least 6% for bar sizes #11 through #18. reinforcing Steel: Plain or deformed bars; ASTM A1035, Grade 100 (100,000 psi), Type CL.
- F. Stirrup and Tie Steel: ASTM A615 grade 60 for all bars, unfinished.
- G. Reinforcing steel used as spiral reinforcing as noted on the drawings shall conform to ASTM A615 unless noted otherwise.
- H. Deformed Bar Anchors: AWS Type D studs manufactured in conformance with ASTM A 496 with a minimum tensile strength of 80,000 PSI. ASTM A 615 reinforcing bars may not be substituted for deformed bar anchors. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that

their Evaluation Service Reports are still valid at the time of intended use on the project:

1. Nelson Stud Welding, Inc.; Nelson D2L Deformed Bar Anchor Studs (ESR-2907).
 2. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823).
- I. Epoxy-Coated Reinforcing Steel: Provide epoxy coated reinforcing bars at the locations indicated on the drawings. Epoxy coated reinforcing bars shall conform to ASTM A 775. Bars that are to be epoxy coated shall conform to the type of steel required for the given situation as noted on the drawings.
- J. Steel Dowels: Same grade as bars to which dowels are connected.
- K. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064 with a yield strength of 65,000 psi. Provide flat sheets only. Spacing and size of wire as indicated in drawings.
- L. Reinforcement Accessories:
1. Tie Wire: FS-QQ-W-461, annealed, minimum 16-gauge, 0.0508 inch.
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - a. Wire support: CRSI class 2.
 - b. Do not use wood, brick, or other objectionable materials.
 - c. Do not use galvanized supports.
 - d. Supports placed against ground: Pre-cast concrete blocks not less than 4 inches square with embedded wire.
 3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.
- M. Welding Electrodes: AWS D1.4, low hydrogen, E70XX series.
- N. Headed Steel Stud Punching Shear Reinforcement: Punching shear reinforcement using headed studs welded to flat bars shall be manufactured in conformance with ASTM A 1044 and approved by the ICC Evaluation Service, Inc. as expressed in an ICC Evaluation Report for use as punching shear reinforcement for slabs and footings designed in accordance with ACI 421.1.
1. Studs
 - a. Nelson Stud Welding Inc.; Nelson Punching Shear Resistor Studs (ESR-1170).
 - b. Tru-Weld Division, TFP Corporation; Tru-Weld Punching Shear Resistor Studs (ESR-2822).
 2. Assemblies
 - a. Dayton Superior Corporation; Dayton Shear Resistance System (ESR-2696).

- b. Decon, Inc.; Decon Studrails (ESR 2494).
 - c. Dywidag Systems International USA, Inc.; Dywidag Shear System (ESR-2534).
 - d. Jobsite Stud Welding, Inc.; Jobsite Stud Welding Punching Shear Resistor Shear Rail Assemblies (ESR-3264).
 - e. Simpson Strong-Tie Company, Inc.; Simpson Strong-Tie Punching Shear Resistor Rail (ESR-2992).
 - f. SRL Industries LTD.; SRL Punching Shear Resistor Shear Rails (ESR-2938).
- O. Hooked Anchorage Replacement: Reinforcing bar terminations shall be manufactured out of ASTM A 576, ASTM A 615, or A 706 material and shall develop the full tensile strength of the bar when installed at the manufacturer's recommended depth.
- 1. The anchorage shall be approved by the ICC Evaluation Service Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
 - 2. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - a. Dextra Manufacturing Co., Ltd; Bartec Mechanical Anchorages for Steel Reinforcing Bars in Concrete (ESR-2166).
 - b. Headed Reinforcement Corporation; HRC 555 Headed Reinforcing Bars (ESR-2935).
 - c. Erico Products, Inc.; Lenton Terminator (ER-3967).

2.2 REINFORCING BAR SPLICING:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; Comply with ACI 318 Chapter 25.
- 1. Mechanical splices shall conform to Type 1 or Type 2 splices. Where not specifically indicated, use type 2 splices.
 - a. Type 1 splice shall develop, in tension and compression, 1.25 times the specified yield strength of the splice bar.
 - b. Type 2 splice shall meet the requirements of Type 1 splice and, in addition, develop the full tensile strength of the splice bar.
 - c. Splices shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review.
 - 2. Manufacturers:
 - a. Headed Reinforcement Corporation (HRC)
 - b. nVent Lenton
 - c. Dayton Superior Corporation
 - d. Splice Sleeve North America, Inc; NMB Splice Sleeve System
 - e. Substitutions: See Division 01 - Product Requirements.

- B. Form Savers: Mechanical devices for connecting dowels and reinforcing bars at construction joints; capable of developing full steel reinforcing design strength in tension and compression.
 - 1. Manufacturers:
 - a. nVent Lenton
 - b. Substitutions: See Division 01 - Product Requirements.
- C. Taper Tie Hole Plug: Mechanical device for plugging tie holes; anchors optional flush or recessed grout.
 - 1. Manufacturers:
 - a. Dayton Superior Corporation
 - b. Substitutions: See Division 01 - Product Requirements.
- D. Grout: Cementitious, non-metallic, non-shrink grout for use with manufacturer's grout sleeve reinforcing bar coupler system.
 - 1. Manufacturers:
 - a. Dayton Superior Corporation
 - b. Substitutions: See Division 01 - Product Requirements.

2.3 FIBER REINFORCEMENT

- A. See specification section 03 30 00.

2.4 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice and to meet requirements of Drawings.
- B. Fabricate reinforcement in accordance with the requirements of ACI 315R where specific details are not shown or where Drawings and Specifications are not more demanding.
- C. Steel reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of bars for bending will not be permitted.
- D. Reinforcing shall not be field bent or straightened without structural engineer's review.
- E. Provide offsets in rebar (1:6 maximum) where required to maintain clearances.
- F. Fusion welding of preassembled cages shall be permitted only under the following conditions:
 - 1. Fusion welding of holding wires to ties, stirrups, and hoops in beams, columns, and grade beams to preassemble reinforcing cages is permissible. The holding

- wire area shall not exceed 5% of the beam, column, or grade beam cross sectional longitudinal steel area. Fusion welding is not allowed to longitudinal reinforcing steel in any beam, column, or grade beam.
2. Fusion welding of holding wires to the ends of the reinforcing steel placed in mats (spread footings, slab reinforcement, etc.) is permitted provided the fusion weld occurs within 6 bar diameters of the free end of the bar (e.g. no allowed at the end of coupled, T-headed, or weld splice bars).
 3. Fusion welding of holding wires shall not occur on a bent portion of a reinforcing bar. Bars may not be bent where a fusion weld occurs.
 4. Holding wires shall conform to ASTM A496.
 5. All reinforcing steel to be welded shall comply with ASTM A706.
 6. Submit complete structural plans indicating which members will use fusion welding process for assembly. Provide complete structural details indicating the size of stirrups and holding wires and welding requirements. Submit a complete shop welding program which includes the following:
 - a. Type of the specific fusion welding machine
 7. Periodic inspection protocol of the in-plant welding. This information shall be submitted to the Structural Engineer (SEOR) and the Owner's Testing Agency for approval. Fusion welding and fabrication is not permitted until approved by the SEOR.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from the required position. All reinforcement shall be accurately set in place, lapped, spliced, spaced rigidly and securely held in place and tied with specified wire at all splices and crossing points. All wire tie ends shall point away from the form. Carefully locate all dowel steel to align with wall and column steel.
 1. Comply with CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as herein specified.
 2. Bars shall be in long lengths with laps and splices as shown. Offset laps in adjacent bars. Place steel with clearances and cover as shown. Bar laps shall be as indicated on the Drawings. Tie all laps and intersections with the specified wire.
 3. For horizontal reinforcement, maintain clear space between parallel bars not less than 1 times nominal reinforcement diameter, but in no case shall clear space be less than 4/3 times maximum size concrete aggregate.
 4. For vertical reinforcement, maintain clear space between parallel bars not less than 1-1/2 times nominal reinforcement diameter, but in no case shall clear space be less than 4/3 times maximum size concrete aggregate.
 5. Reinforcing dowels for slabs shall be placed as detailed. Sleeves may be used if reviewed by the Structural Engineer before installation. Install dowel through all construction and expansion joints for all slabs on grade. Support slab-on-grade joint dowel bars independently of support for slab reinforcement on soil

supported slab bolsters or specially manufactured cradles such that dowel bar remains parallel to slab surface and at right angles to joint during concreting operations. Lightly coat the exposed end of the dowel with a paraffin-base lubricant, asphalt emulsion, form oil, or grease or use a dowel bar sleeve.

6. Provide and place additional reinforcing steel at all sleeves and openings in beams, slabs, and walls as specified on the drawings. Where sleeves or openings not shown on the drawings interrupt the reinforcement, consult with Engineer for instructions for placing and splicing of bars. Provide the required additional reinforcing steel at no additional cost to the Owner.
7. Epoxy-Coated Reinforcement: Use epoxy-coated steel tie wires to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
8. Do not bend reinforcement that is embedded partially in concrete except in locations noted on the drawings or approved by the Engineer.

B. Reinforcement in Composite Metal Deck Slab

1. Composite steel deck slabs shall be reinforced as indicated on the drawings.
2. Extra Reinforcement over Girders: Provide additional reinforcing steel over interior girders as shown on the drawings.
3. Placement of Slab Reinforcement: Provide bolsters, high chairs, and/or additional reinforcing as shown in details on the drawings to support the reinforcing with the clear cover shown on the drawings.

C. Reinforcement in Topping Slabs

1. Provide welded smooth wire reinforcement minimum 6 x 6 W1.4 x W1.4 in all topping slabs unless specified otherwise on the drawings.

D. Bar Supports: Support and securely fasten bars with chairs, spacers and ties to prevent displacement by construction loads or placement of concrete beyond the tolerances specified. Conform to CRSI as a minimum standard.

E. Steel Adjustment:

1. Move within ACI 117 specified allowable tolerances to avoid interference with other reinforcing steel, conduits, or embedded items.
2. Do not move bars beyond allowable without concurrence of Structural Engineer.
3. Do not heat, bend, or cut bars without concurrence of Structural Engineer.
4. Reinforcement shall not be bent after being embedded in hardened concrete.

F. Splices:

1. Provide splices as indicated on the drawings. Splice reinforcing bars only at locations shown on the structural drawings and approved shop drawings. Unauthorized or unscheduled splices not approved by the Engineer in writing will not be accepted.
2. All lap splices in reinforcing steel shall be contact lap splices unless detailed otherwise on the drawings.
3. Maintain proper cover and spacing between reinforcing bars at splices.

4. Lap unscheduled reinforcing bars not otherwise specified with a Class B lap splice.
 5. Lap Splices: Tie securely with wire to prevent displacement of splices during placement of concrete.
 6. Mechanical Splice Devices: Install in accordance with manufacturer's written instructions. Obtain Structural Engineer's review before using. The manufacturer of mechanical splice shall be present for first day's installation.
 7. Do not splice bars except at locations shown without concurrence of Structural Engineer.
 - a. Where splices in addition to those indicated are required, indicate location on shop drawings clearly and highlight "for Engineer's approval".
- G. Repair of Epoxy-Coated Reinforcing: Repair cut and damaged epoxy coatings on fabricated reinforcing before delivery with epoxy repair coating according to ASTM D 3963.
- H. Do not displace or damage vapor barrier.
- I. Accommodate placement of formed openings.
- J. Refer to Structural Drawings for concrete cover requirements over reinforcement.
- K. Concrete shown without reinforcing shall be reinforced as similar parts shown with reinforcing except where concrete is specifically noted to be unreinforced.
- L. Examine surfaces and conditions receiving or affecting the work. Do not proceed until unsuitable conditions have been corrected.
- M. Welding:
1. Welding is only permitted where specifically detailed on Drawings or approved by Engineer.
 2. Employ shielding metal-arc method and meet requirements of AWS D1.4.
 3. Welding is not permitted on bars where the carbon equivalent is unknown or is determined to exceed 0.55.
 4. Welding shall not be done within two bar diameters of any bent portion of a bar which has been bent cold.
 5. Tack welding of reinforcement is not permitted, unless specifically requested by the Contractor and approved by the Structural Engineer of Record.
 6. Welding of crossing bars is not permitted.
- N. Welded Wire Fabric: Install in long lengths, lapping 24 inches at end splices and one mesh at side splices. Offset laps in adjacent widths. Place fabric in approximately the middle of the slab thickness unless shown otherwise on the Drawings by dimension. Wire tie lap joints at 12-inch centers. Use concrete blocks to support mesh in proper position.
- O. Reinforcement shall be free of mud, oil or other materials that may reduce bond at the time concrete is placed. Reinforcement with tightly adhered rust or mill scale will be

accepted without cleaning provided that rusting has not reduced dimensions and weights below applicable standards. Remove loose rust.

P. Protection against rust:

1. Where there is danger of rust staining adjacent surfaces, wrap reinforcement with impervious tape or otherwise prevent rust staining.
2. Remove protective materials and clean reinforcement as required before proceeding with concrete placement.

Q. Refer to notes on Drawings for additional reinforcement requirements.

R. Refer to Mechanical and Electrical Drawings for formed concrete requiring reinforcing steel. All such steel shall be included under the work of this Section.

3.2 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Division 01 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

B. Reinforcing Steel

1. Notify the testing agency and the Architect at least 48 hours before concrete is to be poured or reinforcing is covered up.
2. Before any concrete is poured on any portion of the building, the reinforcing steel and form dimensions will be inspected by the Testing Agency. Any errors or discrepancies shall be corrected before concrete is placed.
3. A testing program is required prior to the start of construction. Testing program to be done in compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in the final testing program.
4. All reinforcing steel whose properties are not identifiable by mill test reports shall be tested in accordance with ASTM A615. One Series of tests for each missing report shall be made and costs shall be borne by the Contractor.
5. When tests are indicated for reinforcing steel on the structural drawings, the reinforcing steel used shall be tested in accordance with ASTM A615. One tensile and one bend test for each 2-1/2 tons of steel or fraction thereof, shall be made.
6. In addition to other required inspections, the following are subject to Special Inspection as per the CBC:
 - a. Placement of Reinforcing Steel
 - b. Welding of Reinforcing Steel
7. A special inspector from the Testing Agency shall be present during all field bending of reinforcement.

8. Installation of deformed bar anchors to be tested in accordance with Section 7.1 of AWS D1.1.
9. Welding of Reinforcement: There shall be continuous inspection during all welding of reinforcement. All butt welds are to be inspected using radiographic testing. At the Owners option recognized non-destructive tests such as resistance, Magnetic Particle Examination, and Liquid Penetrant Inspection may be used to inspect the welds. Inspect shop and field welding in accordance with AWS D1.4, including checking materials, equipment, procedure, and welder qualification as well as the welds. The inspector will use non-destructive testing or any other aid to visual inspection that he deems necessary to assure the adequacy of the weld.
10. Comply with ICC-ES or IAPMO approvals with respect to special inspection required during installation.
11. Testing and inspection of mechanical splices and reinforcing couplers to conform to manufacturer's recommendations and ICC-ES or IAPMO approval.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.02 SECTION INCLUDES

- A. Cast-in-place concrete building elements.
- B. Concrete for composite floor construction.
- C. Elevated concrete slabs.
- D. Slabs on grade.
- E. Concrete foundations.
- F. Grouting of steel base plates.
- G. Joint devices associated with concrete work.
- H. Concrete curing.

1.03 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 04 22 00 – Concrete Unit Masonry
- D. Section 05 12 00 – Structural Steel
- E. Section 05 50 00 – Metal Fabrications

1.04 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the “Design Criteria Notes” in the structural drawings. If not listed in the “Design Criteria Notes”, use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 3. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 - 4. ACI 301 - Specifications for Concrete Construction.
 - 5. ACI 302.1R - Guide to Concrete Floor and Slab Construction.
 - 6. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 7. ACI 305R – Guide to Hot Weather Concreting.
 - 8. ACI 306R – Guide to Cold Weather Concreting.
 - 9. ACI 308R - Guide to External Curing of Concrete.
 - 10. ACI 318 - Building Code Requirements for Structural Concrete.

11. ACI 360R – Guide to Design of Slabs-On-Ground.
12. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
13. ASTM C33 - Standard Specification for Concrete Aggregates.
14. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
15. ASTM C42 – Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
16. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
17. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
18. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete.
19. ASTM C150 - Standard Specification for Portland Cement.
20. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete by the Volumetric Method.
21. ASTM C192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
22. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
23. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
24. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
25. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
26. ASTM C567 – Standard Test Method for Determining Density of Structural Lightweight Concrete.
27. ASTM C618 – Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
28. ASTM C685 – Standard Specification for Volumetric Batching and Continuous Mixing.
29. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
30. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
31. ASTM C1157 – Standard Performance Specification for Hydraulic-Cement.
32. ASTM C1582 - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.
33. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.

1.05 SUBMITTALS

- A. See Division 01 - Administrative Requirements for submittal procedures.
- B. General:
 1. Review of submittals is of a general nature only, and the responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that the fabricator has correctly interpreted the construction documents.
 2. All submissions shall be in accordance with the submission schedule developed and agreed between the Architect and Contractor at the commencement of the project. Submission shall include dates of order and delivery of materials to the shop and the site.
 3. Shop drawing schedule shall allow adequate time for reviews. Reinforcing steel shall not be fabricated or placed before the shop drawings have been reviewed by the Architect and returned.
- C. Concrete Design Mixtures: Each concrete mix design to be used on the project shall be reviewed and approved by the Testing Agency prior to concrete being delivered to site. Owner's Testing Agency shall review all mix designs prior to submittal. Submit proposed mix designs for each class of concrete listed on drawings. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. For each concrete mixture, the following information shall be included: where the mix is to be used, all materials and admixtures including their source and proportions in the mix; Water content, water-to-cement ratio, slump, and aggregate grading; whether the mixture is appropriate for pumping; and total chloride content.
 2. Provide shrinkage test results for mixes with shrinkage criteria showing that mix meets performance criteria. The mix design number must match with the mix design number shown on the test data.
 3. Indicate compressive strength and method used to determine strength. The compressive strength of the concrete shall be proportioned per ACI. Include all calculations and tests required by ACI 318 Chapter 5. Laboratory test data must be submitted along with calculations that show each mix design meets the strength requirement. Mix design number must match the mix design number shown on the test data. Include all test results or past history back up data specific as part of the submittal. Test results within the past two years shall be used to indicate performance in accordance with past history.
 4. Indicate amounts of mixing water to be withheld for later addition at Project site.
 5. Each mix shall be stamped and signed by a Professional Engineer licensed in the State of California with experience in concrete mix design.
- D. Transit-mix delivery slips.
1. Keep record at the Site showing time and place of each pour of concrete, together with transit mix delivery slip certifying contents of the pour per ASTM C94. Include the time water was added to dry mix.
 2. Make the record available for inspection at the Site and to the Architect for his review upon request.
 3. Upon completion of this portion of the Work, deliver the record and the delivery slips to the Architect.
- E. Reinforcement: Comply with submittal requirements in Section 03 20 00.
- F. Formwork and Shoring: Comply with submittal requirements in Section 03 10 00.
- G. Layout drawings for construction, control, and expansion joints for Engineer and Architect review.
- H. Certificates of Compliance from manufacturer or supplier:
1. Material Test Reports:
 - a. Cement Certificates per CBC Chapter 17.
 - 1) Cement without a certificate shall not be used.
 - b. Aggregates: Material test reports for the following, from a qualified testing agency, indicating compliance with requirements:
 - 1) Light weight aggregate (per ASTM C330).
 - 2) Normal weight aggregate (per ASTM C33). Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity. Include evaluation of reactivity.
 2. Product Test Reports and Certificates: Include ICC-ES or IAPMO reports where available. Provide for each of the following, signed by manufacturers.:
 - a. Cementitious materials, per ASTM C150, ASTM C595, ASTM C618, ASTM C989, and/or ASTM C1240, as applicable.
 - b. Admixtures. Where more than one admixture is used, include certification that admixtures are compatible. Per ASTM C494 for each type used; include chloride ion content.
 - c. Fiber reinforcement.
 - d. Curing compounds. Also include data on method of removal in the event of incompatibility with floor covering adhesives.
 - e. Floor and slab treatments.
 - f. Non-shrink grout, per ASTM C1107 Grade B.
 - g. Bonding agents.
 - h. Vapor retarders.

- i. Semirigid joint filler and joint-filler strips
 - j. Waterstops.
 - k. Post-installed concrete anchors.
 - l. Repair materials.
- I. Hardeners and sealers: Provide manufacturer's data.
- J. Grout samples for sacked surface textures and colors upon Architect's request only.
- K. Submit a complete description of the system proposed for meeting the specified floor slab flatwork tolerances. Submit survey data from a minimum of two previous slab installations to demonstrate capability to satisfy specified tolerances.
- L. Field quality-control test and inspection reports.
- M. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318 and applicable standards listed in the Reference Standards section.
 - 1. Maintain one copy of ACI 301 and ACI 318 on site.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.
- D. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for every day of placement except when waived by owner.
- E. For slabs indicated to receive membrane-forming, moisture emission-reducing, curing and sealing compound, do not proceed with application unless manufacturer's representative is present for every day of placement except when waived by owner.
- F. Installer Qualifications:
 - 1. Concrete: A qualified installer who employs Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- G. Manufacturer Qualifications:
 - 1. Concrete: A firm experienced in manufacturing ready-mixed concrete products that complies with ASTM C94 requirements for production facilities and equipment.
 - a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- H. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E548.
 - 1. 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.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. The Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
 - 3. Shop and field testing and inspection of steelwork shall be performed by an inspector currently certified as an AWS Certified Welding Inspector.
- I. Testing Agency: Shall be selected and paid for by the Owner, unless otherwise specified; re-testing paid for by the Contractor.
- J. Contractor's Quality Control Plan: Quality Control includes the functions performed by the Contractor to ensure that the material and workmanship of concrete construction meets the

project specifications and applicable standards. The Contractor shall submit a Quality Control Plan that addresses all inspection issues, including testing and inspection per ACI. The verification testing and inspection carried out by the Testing Agency does not relieve the contractor of the responsibility for conducting their own quality control/inspection program to ensure the requirements of the Contract Documents have been met. The Contractor's Quality Control Plan will be reviewed by the Testing Agency.

- K. Quality Control Inspector Qualifications: Along with Quality Control Plan, Contractor shall submit written qualifications for all inspectors to be assigned Quality Control functions for concrete work.
- L. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- M. Mechanical Bar Couplers shall have a current ICC-ES or IAPMO Evaluation Report that indicates compliance with the requirements of these specifications.
- N. Steel Reinforcing Allowable Tolerances: Comply with ACI 117 and requirements in Section 03 20 00.
 - 1. Refer to Section 03 20 00.
- O. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to test concrete mixtures. When mixes are proportioned by trial batch method, engage a Laboratory conforming to ASTM E329 and under direction of a Professional Engineer licensed in the State in which the Project is located.
- P. Formwork:
 - 1. See Section 03 10 00.
- Q. Prefabrication and Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
 - 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.
 - 2. 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-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.
- R. Tests and Inspections:
 - 1. Provide special inspections and testing as described in the "Statement of Structural Special Inspections and Testing" within the structural drawings, and/or TIO form, and as required by this section.
 - 2. A testing program is required prior to start of construction. Testing program to be done in Compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
 - 3. The following tests shall be made by a recognized testing laboratory selected by the Owner and approved by the governing agency. All tests shall be in accordance with the previously mentioned standards and ACI 318 Section 26.12. A complete record of all tests and inspections shall be kept per CBC Section 1704.5.

- a. Compressive Strength: Make and cure in accordance with ASTM C-31. Test in accordance with ASTM C-39 and ACI 318 Section 26.12. Standard cure testing shall be utilized. Supplementary field cure testing shall occur where required by SEOR and/or AHJ.
 - 1) A record shall be made of time and of locations of concrete from which samples were taken.
 - 2) A minimum of five identical cylinders shall be taken from each pour of 50 cubic yards or 2000 square feet or part thereof, being placed each day per ACI 318 Section 26.12.2. One cylinder shall be tested at age 7 days, and a minimum of three at age 28 days unless otherwise specified. Preserve a minimum of one remaining cylinder for future use.
- b. Drying Shrinkage: (applies always for lightweight concrete; also applies for other mixes if specified as such in drawings or specifications).
 - 1) A record shall be made of time cylinders and of locations of concrete from which samples were taken.
 - 2) Three identical 4" x 4" x 11" specimens shall be made from same concrete as used in structure. Percent of shrinkage shall be reported at 21 days after 7 day moist curing period. Average results of 3 specimens shall be used as the accepted value. The value for laboratory cast specimens shall not exceed .075%. If field test specimens are used in lieu of laboratory specimens, a tolerance of +33% may be used.
 - 3) Test specimens in accordance with ASTM C157.
- c. Concrete consistency (slump) shall be tested in accordance with ASTM C143.
4. Provide full time inspection per CBC Section 1705.3 during the taking of test specimens and during the placing of all concrete and embedded steel.
5. See Section 03 20 00 for reinforcing steel tests and inspections.
6. Provide concrete batch plant inspections per ASTM C685.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Steel Reinforcement:
 1. See Section 03 20 00.
- B. Deliver and store welding electrodes in accordance with AWS D1.4.
- C. Formwork: Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
- D. Concrete Materials:
 1. Protect cement from moisture and rotate stock to ensure fresh materials.
 2. Protect aggregates as necessary to maintain saturated condition when batched.
 3. Storage methods should comply with ACI 301 4.1.4.
- E. Contractor to coordinate with owner and/or testing laboratory to provide facilities for job curing of test cylinders and transporting to Testing Laboratory.
- F. Comply with all local building and fire codes for fire safety during construction.

PART 2 - PRODUCTS

2.01 CONCRETE MIXES

- A. Concrete mixes shall be as stated in the Structural Documents with strength, maximum aggregate size, weight, maximum water to cement ratio, and location of usage.
 - 1. Cement content as required by mix design (ACI 318 Section 26.4.3).
 - 2. Admixtures: Water Reducing
 - 3. Weight
 - a. Normal Weight Concrete (NWC): 150 lbs. per cubic foot maximum
 - b. Lightweight Concrete (LWC): 113 ± 3 lbs. per cubic foot. (Equilibrium Density per ASTM C567)
 - 4. Air Entrainment
 - a. As required for UL rating (4%-7% for LWC)
 - b. As required for Durability Requirements per ACI 318 Chapter 19
 - c. As required in Construction Documents

2.02 FORMWORK

- A. Comply with requirements of Section 03 10 00.

2.03 REINFORCEMENT MATERIALS

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

2.04 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C150, Type II, II/V, Type V, or ASTM C595 Type 1L. One brand of cement shall be used throughout to maintain uniform color for all exposed concrete.
 - 2. Supplement Portland Cement with the following Supplementary Cementitious Materials (SCM):
 - a. Fly Ash Pozzolan: ASTM C618, F as required.
 - b. Blast-Furnace Slag: ASTM C989-10
 - c. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
 - 3. The SCM producer shall have a minimum of 5 years' experience in the production of acceptable SCM and shall practice an effective quality control program to guard against contamination of the SCM.
 - 4. Cementitious material used shall have at least 2 years of use with proposed aggregates without detrimental reaction.
 - 5. Alkali content shall not exceed 0.6% when tested in accordance with ASTM C114.
 - 6. The temperature of cement delivered to the plant shall not exceed 150 degrees F.
- B. Normal-Weight Aggregates: ASTM C33, fine and coarse aggregate, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Aggregate shall be crushed granite or Perkins type.
 - 1. Select coarse-aggregate size from three options in subparagraph below; add gradation requirements if preferred. Aggregate size limits relate to spacing of steel reinforcement, depth of slab, or thickness of concrete member.
 - 2. Coarse Aggregate:
 - a. Aggregate shall contain no thin or elongated pieces. Any piece having a major dimension more than 2-1/2 times the average thickness shall be considered thin or elongated.

- b. If shrinkage-controlled concrete, Coarse Aggregate shall be crushed limestone, granite, or accepted equal.
 - c. The maximum size used in a particular location shall be consistent with the form and dimensions of the section being placed, with the location and spacing of the reinforcing steel and with the method of vibration. The aggregate sizes shall be such as will produce dense, uniform concrete, free of rock pockets, honeycombs, or other irregularities.
 - d. Combined aggregate gradation for slabs and other designated concrete shall be 8% to 18% for large top size aggregates (1-1/2-inch) or 8% - 22% for smaller top size aggregates (1-inch or 3/4-inch) retained on each sieve below the top size and above the No. 100.
- 3. Fine Aggregate: Uniformly graded, clean sand, free from excessive fines, organic materials or other deleterious materials. Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C330, to be specified between 1-inch and 3/8-inch nominal maximum aggregate size.
 - 1. Lightweight cellular and granular inorganic materials, free from oil, organic matter, or other deleterious substances.
 - 2. Uniformly graded from 1/4-inch to maximum size. The combined grading shall be such that the percentage of weight of the combined aggregates shall fall within the limits established by ASTM C330.
 - 3. Dry weight of lightweight concrete shall be as specified above. Comply with ASTM C567 for oven dry density testing if specifically required by code or jurisdiction. Contractor to verify density of concrete meets the requirements of the UL rating.
 - 4. Lightweight Aggregates Rotary Kiln Produced: Expanded shale slate, clay or slag aggregate, the maximum size used in a particular location shall be consistent with the form and dimensions of the section being placed, with the location and spacing of the reinforcing steel and with the method of vibration. The aggregate sizes shall be such as will produce dense, uniform concrete, free of rock pockets, honeycombs, or other irregularities.
- D. Water: Clean and free from injurious amounts of oil, acids, alkali, organic matter and other deleterious substances; suitable for domestic consumption.
- E. Use of shotcrete except where specifically permitted in contract documents is prohibited.
- F. Use of Returned Plastic Concrete (RPC) or Returned Fresh Concrete is prohibited.

2.05 ADMIXTURES

- A. General: Where more than one is used, admixtures shall be compatible. Use of admixtures shall be consistent throughout Work.
 - 1. Use of alternate admixtures may only be used with the written acceptance of the Architect. See Substitutions Division 01 – Product Requirements.
 - 2. Admixtures to be in accordance with ACI 318 Section 26.4.1.4.
 - 3. Prohibited Admixtures: Admixtures containing more than 0.05 percent chloride ions, fluorides, sulphites, thiocyanates, and/or nitrates are not permitted. Do not use admixtures that will negatively impact the visual finish of concrete exposed to view. Calcium chloride is not permitted.
- B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other admixtures.
 - 1. Available Products:
 - a. Grace Construction Materials; Darex AEA or Daravair.
 - b. Master Builders, Inc.; MB-VR or Micro Air.
 - c. Euclid Chemical Company (The); Air Mix.

- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing (Plasticizing) Admixture: ASTM C494, Type A for use in cool weather.
Available Products:
 - a. Grace Construction Products, W. R. Grace & Co.; "WRDA with Hycol".
 - b. Master Builders, Inc.; "Pozzolith 220N".
 - c. Euclid Chemical Company (The); "WR-75, WR-91 or Eucon MR".
 2. Retarding Admixture: ASTM C494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C494, Type D for use in hot weather.
Available Products:
 - a. Sika Corporation; "Sikament 30".
 - b. Euclid Chemical Company (The); "Eucon Retarder-75".
 4. Mid-Range, Water-Reducers ASTM C494. Available Products:
 - 1) Master Builders "Polyheed."
 5. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
 6. Non-Chloride, Non-Corrosive Accelerating Admixture: ASTM C494, Type C or E. Manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method. Available Products:
 - a. Euclid Chemical Company (The); "Accelguard 80, 90, or NCA".
 7. Shrinkage Reducing Admixture: ASTM C494, Type S.
 - a. Euclid Chemical Company; Eucon SRA Floor; Eucon SRA-XT.
 - b. GCP Applied Technologies; Eclipse Floor 200; Eclipse 4500.
 8. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
 - a. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.
 - b. Admixture Composition: Hydrophobic polymer waterproofing and corrosion inhibitor, functioning by closing concrete pores and chemical bonding.
 - c. Permeability of Cured Concrete: No measurable leakage when tested in accordance with COE CRD-C 48 at 200 psi (1.38 MPa); provide test reports.
 - d. Potable Water Contact Approval: National Science Foundation (NSF) certification for use on structures holding potable water, based on testing in accordance with NSF 61 and NSF 372.
 - e. Available Products:
 - 2) Euclid Chemical Company; Eucon Vandex AM-10.
 - 3) W. R. Meadows, Inc; ADI-CON CW Plus.
 - 4) Xypex Chemical Corporation; XYPEX Admix C-500.
- D. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494, Type C.
1. Available Products:
 - a. Euclid Chemical Company (The); Eucon CIA.
 - b. Grace Construction Products, W. R. Grace & Co.; DCI.
 - c. Master Builders, Inc.; Rheocrete CNI.
 - d. Sika Corporation; Sika CNI.
- E. Color Pigment: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
1. Color: As selected by Architect from manufacturer's full range.

2. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.

2.06 FIBER REINFORCEMENT

- A. Fiber reinforcement shall not be used to replace steel reinforcement specified.
- B. Synthetic Micro Fiber Reinforcement: Collated, fibrillated, or monofilament polypropylene, cellulose, or multi-filament nylon fibers conforming to ASTM C 1116, Type III or Type IV. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 1. The Euclid Chemical Company; Fiberstrand Series.
 2. Forta Corporation; Econo-Mono or Econo-Net (ESR-2720).
 3. Propex Concrete Systems Corp.; Fibermesh 300 (ESR-1165).
 4. W.R. Grace & Company; Grace Microfibers (ESR-1506).
- C. Synthetic Macro Fiber Reinforcement: Monofilament polypropylene/polyethylene fibers conforming to ASTM C 1116, Type III having an aspect ratio between 50 and 90 and a minimum tensile strength of 90 KSI. The fiber lengths shall be between 1.5 and 2 inches long. Reinforcement shall be approved by the ICC-Evaluation Service, Inc. and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 1. The Euclid Chemical Company; Tuf-Strand SF.
 2. Forta Corp.; Forta-Ferro.
 3. W.R. Grace; Strux 90/40.
 4. Propex Concrete Systems, Corp.; Fibermesh 650

2.07 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
 1. Sheet Material: ASTM E 1745, Class A, not less than 15 mils thickness. Suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited. Include manufacturer's recommended adhesive or pressure-sensitive tape. Plastic Vapor Retarder shall have a water-vapor transmission rate (WVTR) no greater than .008 perms (grain/h xft² in x Hg) when tested in accordance with ASTM E96. Include manufacturer's recommended tape with water vapor transmission rate no greater than 0.3 perms when tested in accordance with ASTM E96. Tape shall be: a minimum of 6-mils thick, a minimum of 3 ¾ inches wide, manufactured from high density polyethylene, and have pressure sensitive adhesive. Include manufacturer's recommended vapor resistant mastic.
 - a. Sheet Products:
 - 1) Alumiseal Corporation; Zero Perm Vapor Barrier.
 - 2) Henry Company (Fortifiber); Moistop Ultra 15.
 - 3) Raven Industries Inc.; Vapor Block 15.
 - 4) Reef Industries, Inc.; Griffolyn Type-65G or 105.
 - 5) W.R. Meadows, Inc.; PERMINATOR Class A - 15 mils.
 - 6) STEGO Industries LLC; Stego Wrap Vapor Barrier.
 - 7) Substitutions: See Section 01 60 00 - Product Requirements.
 - b. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - 1) Vapor Retarder Tape:
 - (a) Water Vapor Transmission Rate: ASTM E 96, 0.3 perms or lower
 - (b) Minimum 6-mils thick
 - (c) Minimum 3 ¾ inches wide

- (d) Manufactured from High Density Polyethylene
 - (e) Pressure Sensitive Adhesive
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents. Acceptance by Architect required before using.
 - 1. Grout: Comply with ASTM C1107.
 - 2. Height Change, Plastic State; when tested in accordance with ASTM C827:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.
 - 3. When placed at a flowable consistency there shall be at least 95% bearing under an 18 inches x 36 inches base plate.
 - 4. Minimum Compressive Strength at 48 Hours: 3,000 pounds per square inch.
 - 5. Minimum Compressive Strength at 28 Days, ASTM C109: 7,000 pounds per square inch
 - 6. Flowable Products:
 - a. Euclid Chemical Company; Hi-Flow Grout.
 - b. W. R. Meadows, Inc; 588-10K; 1428 HP.
 - c. BASF Construction Products; Masterflow 713 or 928.
 - d. Sika Corporation; Sika Grout 328.
 - e. SpecChem; SC Precision Grout
 - f. Metallic grout equivalent to Master Builders "Embeco" may be used only where covered by earth, concrete, or masonry.
 - g. Substitutions: See Division 01 - Product Requirements.
 - 7. Low-Slump, Dry Pack Products:
 - a. Dry Pack products may only be used where approved by Architect or otherwise indicated in Drawings.
 - 1) Euclid Chemical Company; DRY PACK GROUT.
 - 2) Five Star Products, Inc; Five Star Grout.
 - 3) L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Duragrout.
 - 4) SpecChem, LLC; SC Multipurpose Grout.
 - 5) W. R. Meadows, Inc; PAC-IT.
 - 6) Substitutions: See Division 01 - Product Requirements.
- C. Non-Shrink Epoxy Grout: For anchor reinforcing steel or threaded rods in concrete. Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
 - 1. Composition: High solids content material exhibiting positive expansion when tested in accordance with ASTM C827.
 - a. Maximum Height Change: Plus 4 percent.
 - b. Minimum Height Change: Plus 1 percent.
 - 2. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch (82.7 MPa).
 - 3. Products:
 - a. BASF Construction Products; Masterflow MP
 - b. Sika Corporation; Sikadur 32 Hi-Mod
 - c. Euclid Chemical Company; Epoxy 452 or E3G.
 - d. Five Star Products, Inc; Five Star DP Epoxy Grout.
 - e. SpecChem, LLC; SpecPoxy Grout.
 - f. Substitutions: See Division 01 - Product Requirements.
- D. Floor Leveling and Fill Materials
 - 1. Epoxy Concrete Mortar (where areas to fill are less than ¼-inch thick): Floor leveling, non-shrink trowel applied epoxy concrete mortar.
 - 2. Concrete Mortar (where areas to fill are greater than ¼-inch thick): Floor leveling, patching and repair, non-shrink trowel applied concrete mortar.

3. Cementitious Floor Leveling Material: Shall be self-leveling or trowelable with a minimum 28 day compressive strength of 3000 psi in accordance with ASTM C-109.
 - a. The Quikrete Companies; Quikrete No. 1249.
 - b. Ardex; V-1200.
 - c. Mapei; "UltraFlex".
 - d. Substitutions: See Division 01 - Product Requirements.

2.08 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059, Type II acrylic emulsion or styrene butadiene.
 - a. Euclid Chemical Company; AKKRO-7T; Wuco-Weld.
 - b. W. R. Meadows, Inc; ACRY-LOK.
 - c. Sonneborn; Sonobond.
 - d. Larsen Products; Weld-Crete.
 - e. Substitutions: See Division 01 - Product Requirements.
- B. Epoxy Bonding System:
 1. Complying with ASTM C881 and of Type required for specific application. 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, and as follows:
 - a. Types I and II, non-load bearing or IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 1) CTS Cement Manufacturing Corporation; Fast Anchoring and Repair Adhesive.
 - 2) Euclid Chemical Company; DURAL FAST SET LV.
 - 3) Mapei Corporation; Planibond AE, Planibond 3C.
 - 4) Substitutions: See Division 01 - Product Requirements.
- C. Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline waterproofing additive, mixed with water in proportions recommended by manufacturer to achieve waterproofing at cold joints in concrete.
 1. Products:
 - a. W. R. Meadows, Inc; ADI-CON CW Plus.
 - b. Xypex Chemical Corporation; XYPEX Concentrate.
 - c. Substitutions: See Division 01 - Product Requirements.
- D. Waterstops:
 1. Rubber, complying with COE CRD-C 513.
 2. PVC, complying with COE CRD-C 572.
 3. Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
 4. Synthetic rubber; swells to 1000 percent of original size in clean water.
 5. Configuration: As indicated on drawings.
 6. Size: As indicated on drawings.
 7. Products:
 - a. Penetron; Penebar SW-55.
 - b. CETCO, a division of Minerals Technologies Inc; WATERSTOP RX.
 - c. Kryton International, Inc; Krytonite Swelling Waterstop.
 - d. Substitutions: See Division 01 - Product Requirements.
- E. Reglets: Formed steel sheet, galvanized, not less than 26 gauge, with temporary filler to prevent concrete intrusion during placement.
- F. Slab Expansion and Isolation Joint Filler: Preformed non-extruded resilient filler.
 1. Material:
 - a. ASTM D1751, cellulose fiber.
 - b. ASTM D1752, sponge rubber (Type I).
 - c. ASTM D8139, semi-rigid, closed-cell polypropylene foam.

2. Products:
 - a. Burke; Fiber Expansion Joint.
 - b. W.R. Meadows; Fibrated Expansion Joint Filler with Snap-Cap; Deck-O-Foam Joint Filler with pre-scored top strip.
 - c. Nomaco, Inc; Nomaflex Expansion Joint Filler with Void Cap Option.
 - d. Substitutions: See Division 01 - Product Requirements.
- G. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
- H. 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.
 1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
 2. Height: To suit slab thickness.

2.09 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
 1. Conform with State of California Air Resources Board VOC Regulations.
 2. Products:
 - a. Euclid Chemical Company ; EUCOBAR.
 - b. Kaufman Products Inc; VaporAid.
 - c. W. R. Meadows, Inc ; Evapre or Evapre-RTU.
 - d. Substitutions: See Division 01 - Product Requirements.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309:
 1. Type 1, Class A and B, and AASHTO Specification M-148;
 2. Type 1, Class A and B requirements, and State of California Air Resources Board VOC Regulations.
 3. Sodium Silicate compounds are prohibited.
 4. Certified by curing compound manufacturer to not interfere with bonding of floor covering.
 5. Product dissipates within 4 to 6 weeks.
 6. Products:
 - a. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC.
 - b. W. R. Meadows, Inc; 1100-Clear.
 - c. Substitutions: See Division 01 - Product Requirements.
- C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
 1. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested according to ASTM C39.
 2. Conform with State of California Air Resources Board VOC Regulations.
- D. Resin Curing Compound: Solvent-based liquid, white pigmented, membrane-forming.
 1. For use on exterior slabs. When slab will be painted, sealed, topped, or receive other applied finish, completely remove curing compound after curing is complete and before finish coatings are applied.
 2. Comply with ASTM C309, Type 2, Classes A and B.
 3. Conform with State of California Air Resources Board VOC Regulations.
 4. VOC Content: Less than 200 g/L.
 5. Solids Content: 20 percent, minimum.
 6. Products:

- a. Euclid Chemical Company; KUREZ DR-VOX; KUREZ DR-100.
 - b. Kaufman Products Inc; Thinfilm 450 Resin Base.
 - c. Substitutions: See Division 01 - Product Requirements.
- E. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Clear, liquid sealer for application to newly-placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.
 - 1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
 - 2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
 - 3. Conform with State of California Air Resources Board VOC Regulations.
 - 4. VOC Content: Less than 100 g/L.
 - 5. Solids Content: 25 percent, minimum.
 - 6. Sodium silicate compounds prohibited.
 - 7. Products:
 - a. Euclid Chemical Company; Diamond-Clear VOX
 - b. Floor Seal Technology, Inc; VaporSeal 309 System.
 - c. Spec Chem; Cure & Seal WB.
 - d. ShawContract; Moisture Shield
 - e. Substitutions: See Division 01 - Product Requirements.
- F. Curing and Sealing Compound, Moisture Emission-Reducing, Penetrating: Clear, water-based, non-film-forming curing agent; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission, moisture vapor emission, and alkalinity.
 - 1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
 - 2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 28-day water cure when tested according to ASTM C39.
 - 3. Chloride Ion Resistance of Treated Concrete: Equal to or greater than strength after 28-day water cure when tested according to ASTM C1202.
 - 4. Comply with ASTM C309 and ASTM C1315 Type I Class A.
 - 5. Conform with State of California Air Resources Board VOC Regulations.
 - 6. Products:
 - a. W.R. Meadows; Pentreat 244.
 - b. Substitutions: See Division 01 - Product Requirements.
- G. Curing and Densifying Compound, Membrane-Forming: Lithium polysilicate-based, clear, liquid densifier for application to newly-placed concrete.
 - 1. Comply with ASTM C309.
 - 2. Conform with State of California Air Resources Board VOC Regulations.
 - 3. Solids Content: 25 percent, minimum.
 - 4. Products:
 - a. BASF; Sonosil.
 - b. Euclid Chemical Company; Eucosil.
 - c. Substitutions: See Division 01 - Product Requirements.
- H. Moisture-Retaining Sheet/Cover: ASTM C171.
 - 1. Provide in a thickness of 42 mils; standard weight of 53 lbs./1000 ft²; tensile strength (machine direction) of 36 lbs./in.; and puncture resistance of 70 lbs.
 - a. Fiber reinforced asphaltic vapor barrier building paper, regular.
 - b. Polyethylene film, white opaque.
 - c. White-burlap-polyethylene sheet.
- I. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- J. Water: Potable, not detrimental to concrete.

2.10 FLOOR AND SLAB TREATMENTS

- A. Abrasive Aggregate for non-slip finish: Fused aluminum oxide grits, graded 12/30. Use factory graded rustproof and non-glazing material that is unaffected by freezing, moisture and cleaning materials.
- B. Concrete Hardener/Sealer: Clear, water soluble, sprayable in-organic silicate-based hardener/sealer or acrylic co-polymer resin. Shall conform to State of California Air Resources Board VOC Regulations.
- C. Concrete Sealer: Conforming to ASTM C-309, Type I, Class B requirements, and conforming to State of California Air Resources Board VOC Regulations.
- D. Sealer for Colored Concrete: Clear, penetrating, water-based, low-luster sealer recommended by the pigment manufacturer. It shall be compatible with colored concrete components and will not adversely affect concrete color or slip resistance.

2.11 POST-INSTALLED CONCRETE ANCHORS

- A. Expansion Anchors:
 - 1. As indicated on Drawings.
- B. Adhesive Anchors:
 - 1. As indicated on Drawings.
- C. Screw Anchors:
 - 1. As indicated on Drawings.
- D. Grouted Dowels / Grouted Anchors: High strength non-shrink grout to anchor reinforcing steel or threaded rods in concrete.
 - 1. Master Builders; Masterflow 928.
 - 2. Sika Corporation; Sika Grout 212.
 - 3. Substitutions: See Division 01 - Product Requirements.

2.12 REPAIR MATERIALS

- A. High Strength Flowing Repair Mortar: For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate. The product shall achieve 9000 psi @ 28-days at a 9-inch slump.
- B. Concrete Patching Mortar:
 - 1. Horizontal repairs, ASTM C1059, Type II. Available Products:
 - a. Euclid Chemical Co.; Euco Thin Coat, Concrete Coat.
 - b. Sika Chemical Corp.; Sikatop 121 or 122.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Vertical or Overhead repairs, ASTM C1059, Type II. Available Products:
 - a. Euclid Chemical Co.; Verticoat.
 - b. Sika Chemical Corp.; Sikatop 123.
 - c. Master Builders; Emaco R300, 310 or R350.
 - d. Substitutions: See Division 01 - Product Requirements.
- C. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than specified strength at 28 days when tested according to ASTM C109.
 5. Bond Strength: Not less than specified strength at 28 days when tested according to ASTM C1042.
 6. Available Products:
 - a. Euclid Chemical Co.; Flo-Top.
 - b. Master Builders; UnderLayment 110.
 - c. Substitutions: See Division 01 - Product Requirements.
- D. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than specified strength at 28 days when tested according to ASTM C109.
 5. Product shall exhibit the following properties: Chaplin Abrasion Test – 0.0079-inches maximum at 28 days.
 6. Available Products:
 - a. Euclid Chemical Co.; Thin Top SL.
 - b. Master Builders; Topping 112.
 - c. Substitutions: See Division 01 - Product Requirements.

2.13 CONCRETE MIX DESIGN

- A. General:
1. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - a. Procurement of concrete mix design is responsibility of Contractor.
 - b. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
 - c. Contractor shall notify the Testing Laboratory and Architect of intent to use concrete pumps to place concrete so that mix designs can be modified accordingly.
 2. Supplementary Cementitious Materials (SCM): Fly ash shall not exceed 25% of the total cementitious material, unless otherwise indicated by Architect and Structural Engineer. Where slag is used to replace cement, slag shall not exceed 25% of the total cementitious material by mass. Ternary systems where more than one supplementary cementitious material is used are prohibited without consent of SEOR.
 3. Limit water-soluble, chloride-ion content in hardened concrete to specified percent by weight of cement.
 4. Admixtures: Use admixtures according to manufacturer's written instructions.
 - a. Use admixtures in concrete, as required, for placement and workability.
 - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - c. 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.
 - d. Use corrosion-inhibiting admixture in concrete mixtures where required.

5. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- B. Mixtures:
1. Initial mix design shall be prepared for all concrete in accordance with ACI 318 Section 26.4.3. Mix proportions shall be determined in accordance with ACI 318 Section 26.4.3 or 26.4.4. In the event that additional mix designs are required due to depletion of aggregate sources, aggregate not conforming to Specifications or at request of Contractor, these mixes shall be prepared as above.
 2. Definition of Mix Properties to be specified for each mix:
 - a. Concrete density, either normal or light weight concrete.
 - b. Concrete strength (f'_c) as the minimum compressive strength at a specified number of days, tested in accordance with ASTM C39.
 - c. Aggregate size as the largest of the coarse aggregate.
 - d. Slump limit. Slump shall be measured at the point of delivery in accordance with ASTM C143 prior to the addition of superplasticizer (if used). Slump tolerance shall meet the requirements of ACI 117 and shall be 4 inch plus or minus 1 inch for general concrete placement. Mixes employing the specified mid-range water reducer shall provide a measured slump not to exceed 7 inch \pm 1 inch after dosing, 2 inch \pm 1 inch before dosing. Use water reducing admixtures as required to provide a workable consistency for pump mixers. Water shall not be added at the jobsite without written review by the structural engineer.
 - e. Air entrainment: Provide 6% air entrainment typical for exterior concrete exposed to freeze-thaw cycles. Provide required air entrainment to meet the exposure categories listed in the concrete general notes per ACI 318, Chapter 19.
 - f. Air content by volume and may be plus or minus 1.5 percent at point of delivery.
 - g. Water/cement ratio is a maximum and specified by weight.
 - h. SCM cement replacement ratio as a %.
 - i. Drying shrinkage limit (where required) as a percentage change in length after 21 days of drying when tested as per ASTM C157 with 4 inches x 4 inches x 11 inches specimen moist cured 7 days prior to drying.
 - j. Fiber reinforcement (where used) specified as weight/volume of concrete.

2.14 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for slabs-on-grade and building footings
1. Minimum compressive strength: 5,000 psi at 28 days
 2. Maximum w/c ratio: 0.40.
 3. Slump Limit: 4 inches, plus or minus 1-inch.
 4. Air content: 1%
- B. Class B: Normal-weight concrete used for swimming pool footings, swimming pool floors and splashpad floor.
1. Minimum compressive strength: 4,500 psi at 28 days
 2. Maximum w/c ratio: 0.45.
 3. Slump Limit: 3 inches, plus or minus 1-inch
 4. Air Content: 5%
- C. Class C: Normal-weight concrete used for shade structure footings.
1. Minimum compressive strength: 4,000 psi at 28 days
 2. Maximum w/c ratio: 0.45.
 3. Slump Limit: 4-inches, plus or minus 1-inch.
 4. Air Content: 2%
- D. Class D: Normal-weight concrete used for scoreboard footings.
1. Minimum compressive strength: 4,500 psi at 28 days
 2. Maximum w/c ratio: 0.45.

3. Slump Limit: 4-inches, plus or minus 1-inch
4. Air Content: 1.5%

2.15 MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 or ASTM C685 and ASTM C 1116 (fiber reinforced concrete when applicable), and furnish batch ticket information.
 1. The batching plant shall be equipped with an electric metering device capable of determining moisture content of sand.
 2. Begin the mixing operation within thirty minutes after the cement has been intermingled with the aggregates.
 3. After mix water has been added, concrete shall be mixed not less than 1-1/2 minutes nor more than 1-1/2 hours. Concrete shall be rejected if not deposited within the time specified.
- B. Project-Site Mixing: Use only if method of storing material, mixing of material and type of mixing equipment is approved by Architect. Approval of site mixing does not relieve Contractor of any other requirements of Specifications. Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. 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., increase mixing time by 15 seconds for each additional 1 cu. yd.
 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.
- C. Lightweight Concrete: Mix lightweight concrete in accordance with the directions of the approved lightweight aggregate manufacturer.
- D. Admixtures:
 1. Air entrained and chemical admixtures shall be charged into mixer as a solution and shall be dispensed by an automatic dispenser or similar metering device. Powdered admixtures shall be weighed or measured by volume as recommended by manufacturer. Accuracy of measurement of any admixture shall be within plus or minus 3%.
 2. Two or more admixtures may be used in same concrete, provided such admixtures are added separately during batching sequence, and provided further that admixtures used in that combination retain full efficiency and have no deleterious effect on concrete or on properties of each other.
 3. All admixtures are to be approved by Structural Engineer prior to commencing this work.
- E. Re-tempering:
 1. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall be discarded, not re-tempered.
 2. Indiscriminate addition of water to increase slump is prohibited.
 3. When concrete arrives at project with slump below that suitable for placing, water may be added only if neither maximum permissible water-cement ratio nor maximum slump is exceeded. Water shall be incorporated by additional mixing equal to at least half of total mixing time required. Any addition of water above that permitted by limitation of water-cement ratio shall be accompanied by a quantity of cement sufficient to maintain proper water-cement ratio. Such additions shall only be used if approved by Architect. In any event, with or without addition of cement, not more than 2 gallons of water per cubic yard of concrete, over that specified in design mix, shall be added.
- F. Cold Weather Batching:

1. When average of the highest and lowest air temperature falls below 40 degrees F for more than three consecutive days, provide adequate equipment for heating concrete materials. No frozen materials or materials containing ice shall be used. When placed in forms, concrete placed in these temperatures shall have a minimum temperature based on dimensions of concrete sections placed per ACI 301.
- G. Hot Weather Batching:
 1. Concrete deposited in hot weather shall have a placing temperature below 95 degrees F per ACI 301. If necessary, ingredients shall be cooled to accomplish this.
- H. Do not use shrinkage-reducing admixture (SRA) in same concrete batch with a moisture vapor reduction admixture (MVRA) or porosity inhibiting admixture (PIA).

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Prior to Work specified in this Section, carefully inspect the installed Work of other trades and verify that such Work is complete to the point where this installation may properly commence.
- B. Formwork: Comply with requirements of Section 03 10 00.
- C. Reinforcement: Comply with requirements of Section 03 20 00.
- D. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- E. Notify the Architect at least 48 hours in advance of the beginning of pouring operations and at the completion of formwork and location of all construction joints. An inspection of forms and joints will be made for approval of finished work and general layout only. The foregoing inspection shall in no way relieve the Contractor of responsibility of design and safety or formwork, bulkheads and shorings.
- F. Ensure Excavations are sufficient to permit placement, inspection, and removal of forms. The entire place of deposit shall have been cleaned of wood chips, sawdust, dirt, debris, hardened concrete and other foreign matter. No wooden ties or blocking shall be left in the concrete except where indicated for attachment of other work.
- G. Concrete surfaces to which fresh concrete is to be bonded shall be brush cleaned to remove all dust and foreign matter and to expose the aggregate, and then coated with the bonding adhesive herein specified.
- H. Prior to placing concrete for any slabs on grade, the moisture content of the subgrade below the slabs shall be adjusted to at least optimum moisture.
- I. Verify geotechnical engineer has approved all foundation excavations.
- J. No concrete shall be placed until formwork and reinforcement has been approved by Architect. Clean forms of all debris and remove standing water. Thoroughly clean reinforcement and all handling equipment for mixing and transporting concrete. Concrete shall not be placed against reinforcing steel that is hot to the touch.
- K. Coordinate:
 1. Obtain necessary information for coordination of formwork with items to be embedded in concrete.
 2. Coordinate size and location of openings in concrete. Obtain Architect's approval for openings not shown on Structural Drawings.
- L. Discrepancies:

1. Notify the Architect of any discrepancies or inconsistencies.
 2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.
- M. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 2. Use latex bonding agent only for non-load-bearing applications.
- N. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
- O. Concrete Slabs on Grade:
1. Bases below exterior and interior slabs on grade shall be accurately leveled and compacted prior to placing of concrete.
 2. Unless otherwise indicated, interior slabs on grade shall be poured over a minimum of four (4 inch) inches of compacted crushed rock, over a vapor retarder. Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
 3. Protect slab on grade subbase from moisture prior to placing concrete. Avoid wetting rock layer to allow adequate concrete curing and avoid future vapor transmission. If the subbase has been wet excessively, verify that water has been eliminated prior to placement of concrete.

3.03 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. Ensure that embedded items are placed and held, during placing of concrete, to tolerances consistent with other items that will be attached to them.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.
 4. Install concrete accessories in accordance with manufacturer's recommendations: straight, level, and plumb.
- B. Provide pipe sleeves when pipes pass through concrete. Fill voids in sleeves, inserts and anchor slots with readily removable material to prevent entry of concrete into voids. The Contractor shall also see that sleeves have been installed and other provisions have been made for the installation of mechanical, electrical and other equipment.
- C. No conduit shall be cast in concrete unless specifically indicated on the Structural Drawings.
- D. Coring of concrete after placement is not permitted without prior approval by the Engineer of Record.

3.04 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.
- E. Post-Installed Concrete Anchors
 - 1. Install in accordance with the manufacturer's recommendations and ICC-ES (or IAPMO) reports.
 - 2. Use washers on all bolts.
 - 3. Use care to avoid cutting or damaging reinforcing bars.
 - 4. When exposed to view in the final structure, bolts shall be of a length that will extend entirely through but not more than 1/4-inch beyond the nuts unless otherwise shown on the Drawings.

3.05 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Existing Concrete to New Concrete Joints
 - 1. Chip keys and roughen existing concrete surfaces where new concrete abuts. Roughen surface by bush-hammering, chipping or sandblasting to remove surface mortar and expose clean aggregate.
 - 2. Drill and install dowels using epoxy grout in accordance with manufacturer's printed recommendations.
 - 3. Prime surface with 10-mil layer of epoxy adhesive using a stiff brush. Place concrete while the epoxy adhesive is still tacky. Re-prime if necessary.
- C. Construction Joints: Comply with ACI 318 and install only as indicated and noted on Drawings. Joints not indicated on Drawings shall be so located, when approved, as to least impair strength of structure, and shall conform to typical details. Construction joints shall have level tops, vertical sides. Horizontal construction joints shall be thoroughly cleaned and roughened by removing entire surface film and exposing clean aggregate solidly embedded in mortar matrix. Joints between concrete and masonry shall be considered construction joints. Vertical construction joints need not be roughened unless noted otherwise. See Drawings for doweling and required keys. 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 unless otherwise indicated. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. In walls, do not space construction joints more than 60 feet apart in horizontal direction and maximum 20 feet apart in vertical direction unless otherwise shown. In framed slabs and beams, and on metal deck slabs, do not space construction joints more than 120 feet apart. Place construction joints perpendicular to main reinforcement except as otherwise shown. Continue reinforcement across construction joints except as otherwise shown.
 - 3. Form keyed joints at indicated locations. Embed keys at least 1-1/2 inches into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Roughen surface at all construction joints where key is not used and under baseplates. Roughen concrete surface while concrete is still green where possible. Do not leave laitance, loosened particles of aggregate or damaged concrete at surface. Forms and reinforcing shall be cleaned of drippings. Dampen contact surfaces of construction joints, leaving them free of standing water, before placing fresh concrete. Roughen construction joints by any of following methods:
 - a. By sand-blasting joint.
 - b. By thoroughly washing joint, using a high-pressure hose, after concrete has taken initial set. Washing shall be done not less than 2 hours nor more than 4 hours after concrete has been poured, depending upon setting time.
 - c. By chipping and wire brushing.
 8. All decisions pertaining to adequacy of construction joint surfaces and to compliance with requirements pertaining to construction joints shall be reviewed with the Structural Engineer.
 9. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 10. Before placing regular concrete mix, horizontal construction joint surfaces shall be covered with a layer of mortar composed of cement and fine aggregate of same proportions as that used in prescribed mix but omitting coarse aggregate.
- D. Control Jointing in Slabs-on-Grade: Joints shall be in locations indicated on Drawings, or as directed by Architect. Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints as follows:
1. Construct interior slab control joints as follows:
 - a. By use of construction joints laid out in checkerboard pattern; pour and allow alternate slabs to set; fill out balance of checkerboard pattern with second pour.
 - b. By use of dummy groove joints at least 1/4 depth of slab, and at least 1/8 inch wide. These joints may be sawcut as soon as wet concrete can support the weight of the equipment and operator. Delaying saw-cutting past this point will make jointing ineffective. Use power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 2. Slab reinforcing need not be terminated at control joints.
 3. Construction and expansion joints shall be counted as control joints.
- E. Isolation/Expansion Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Unless otherwise indicated, use 3/8 inch thick expansion joint filler.
 2. Joints in interior slabs on grade shall be only in locations indicated.
 3. Edges of concrete at joints shall be edger finished to approximately 3/8 inch radius.
 4. Interrupt reinforcing at all expansion joints.
 5. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 6. 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 are indicated.
 7. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- F. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

- G. Joint Filling:
1. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - a. Defer joint filling until concrete has aged at least a specified length of month(s). Do not fill joints until construction traffic has permanently ceased.
 2. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
 3. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.06 PLACING CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Ensure that all foreign material has been removed from surfaces, including reinforcement and embedded items, against which concrete will be placed.
- B. Contractor shall notify the Testing Laboratory and Architect of intent to use concrete pumps to place concrete. Mix designs shall be modified accordingly as required.
- C. The addition of water to the mix after leaving the plant is permitted only when the added water would not cause the mix design water/cement ratio to be exceeded. The addition of water at the site is contingent upon full-time inspection of the process by the owners testing laboratory and the acceptance of the Inspector. Comply with ACI 301, section 4.3.2.1.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- E. Method: Convey concrete as rapidly and directly as practicable to preserve quality and to prevent segregation. Deposit concrete in forms as nearly as practicable at its final position in a manner which will ensure that required quality is obtained. Chutes shall slope not less than 4 inches and not more than 6 inches per foot of horizontal run.
1. Do not deposit concrete that has initially set. Retempering of concrete, which has partially set, is not permitted.
 2. The maximum time for discharge of concrete shall be per ASTM C94.
- F. Sequence: Pour all walls and columns full height to designated construction joints. Pour all beams, and horizontal structures to designated construction joints. Construction joints to be made in walls only where indicated on the Drawings.
- G. Placement: Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete. Deposit concrete to avoid segregation.
1. Once placing is started, carry it on as a continuous operation until placement of the panel or section is complete. Construction joints to be made only where indicated on the Drawings or on approved shop drawings. Prevent the formation of cold joints at other locations.
 2. Deposit concrete 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 in a manner to avoid inclined construction joints.
 3. Particular care shall be used when starting a concrete pour to maintain the continuity of appearance. Use all means necessary to avoid blemishes, imperfections, or changes in the finish.
 4. Maintain reinforcement in position on chairs during concrete placement.
 5. Deposit concrete into forms in horizontal layers not exceeding 24 inches in thickness around building, proceeding along forms at a uniform rate and consolidating into previous pour. In no case shall concrete be poured into an accumulation of water ahead of pour, nor shall concrete be flowed along forms to its final place of deposit. Fresh concrete shall not be permitted to fall from a height greater than 6 feet without use of adjustable length pipes or, in narrow walls, of adjustable flexible hose sleeves. Concrete shall be scheduled

so that placing is a continuous operation for the completion of each section between predetermined construction joints. If any concreting operation, once planned, cannot be carried on in a continuous operation, concreting shall stop at temporary bulkheads, located where resulting construction joints will least impair the strength of the structure. Location of construction joints shall be as shown on the drawings or as approved by Structural Engineer. The rate of rise in walls shall not be less than 2 feet per hour.

- H. Consolidation: Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners. Concrete shall be thoroughly compacted and worked to all points with solid continuous contact to forms and reinforcement to eliminate air pockets and honeycombing.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301. Use and type of vibrator shall conform to ACI 309, Guide for Consolidation of Concrete.
 - 2. 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. Place vibrating element directly in concrete and not attached to either inside or outside of forms or to reinforcing steel.
 - 3. 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. Do not over-vibrate concrete.
- I. Initial Finishing:
 - 1. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 2. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.
 - 3. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- J. Concrete Slabs on Grade:
 - 1. Exterior and interior concrete slabs on grade shall be poured as required under this Section. Base shall be accurately leveled and compacted prior to placing of concrete.
 - 2. Typically, interior slabs on grade shall be poured over a minimum of four (4 inch) inches of clean crushed rock, unless otherwise indicated, over a vapor retarder. Base section shall meet the requirements within the Geotechnical Engineering report.
 - 3. Protect slab on grade subbase from moisture prior to placing concrete. Avoid wetting rock layer to allow adequate concrete curing and avoid future vapor transmission. If the subbase has been wet excessively, verify that water has been eliminated prior to placement of concrete.
 - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
- K. Concrete Over Metal Deck:
 - 1. At floor slabs, increase fill thickness as required to compensate for deflection of beams and deck at no additional cost to Owner. Obtain specified fill thickness at high points of the deck. Finish floor to specified tolerances for floor flatness, including at concrete over metal deck floors. Refer to 05 30 00 Metal Decking Specification.
 - 2. At roof, maintain specified thickness of concrete uniformly over deck. Slab need not conform to flatness and levelness tolerances
- L. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Concrete placed in these temperatures shall have a minimum temperature based on dimensions of concrete sections placed as shown in ACI 301. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When concrete is expected to be placed at air temperatures of less than 40 deg F, contractor shall review with Architect all special procedures that will be used including mix design modifications and methods of protection. This review shall occur prior to the expected extreme temperatures.

2. Provide sufficient protection material and equipment on the Project site in advance of the time when the mean daily temperatures are expected to drop below 40 degrees F.
 3. 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. In addition, take precautions including, but not limited to:
 - a. Use non-chloride, non-corrosive accelerating admixture in accordance with previously accepted submittals.
 - b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - c. Do not use calcium chloride, salt, or other materials containing antifreeze agents unless otherwise specified and approved in mixture designs.
- M. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1 and as follows:
1. When concrete is expected to be placed at air temperatures of greater than 75 deg F, contractor shall review with Architect all special procedures that will be used including mix design modifications and methods of protection. This review shall occur prior to the expected extreme temperatures.
 2. Provide sufficient protection material and equipment on the Project site in advance of the time when the mean daily temperatures are expected to rise above 75 degrees F.
 3. When air temperature exceeds 75 deg F, take special precautions to prevent slump loss, rapid setting, and plastic shrinkage; including but not limited to:
 - a. Maintain concrete temperature below 95 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.
 - b. Keep aggregate piles continuously moist by sprinkling with water. Temperature of Concrete: The temperature of the concrete mix at the time it is being placed in the forms shall not exceed 95 degrees F per ACI 301. The method employed to provide this temperature shall in no way alter or endanger the design mix or the design strength required.
 - c. Use set retarding admixture in accordance with previously accepted submittals.
 - d. Convey, deposit, finish and commence curing of concrete as rapidly as practicable.
- N. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- O. Minimize evaporation from concrete in place by providing shade and windbreaks. Maintain such protection in place for 14 days minimum.

3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Surfaces shall be reasonably true to line and plane with no specified requirements for selected facing materials. Tie holes and defects shall be patched and fins exceeding 1/4 inch in height shall be rubbed down with wooden blocks. Fins and other rough spots at surfaces to receive membrane waterproofing shall be completely removed and the surfaces rubbed smooth. Otherwise, remove fins and other projections exceeding a specified height agreed with Architect. Rough finish shall be used for the following areas:
 1. Below grade and unexposed surfaces.
- B. Smooth-Formed Finish: As-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 defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- C. Smooth Plywood Form Finish: Finish shall be true to line and plane. Tie holes and defects shall have been patched and ground with surface fins removed. Arrangement of plywood sheets shall be orderly, symmetrical, as large as practical and free of torn grain or worn edges. Surface concrete shall be treated with 1 part muriatic acid, in three parts water solution, followed

immediately by a thorough rinsing with clear water. Surfaces which are glazed, have efflorescence, or traces of form oil, curing compounds or parting compounds shall be cleaned or treated to match other formed surfaces, except as otherwise indicated or specified.

1. Smooth Plywood Form Finish shall be used for the following areas:
 - a. All surfaces above grade unless otherwise specified.
 - b. At Contractor's option, may also be used in lieu of rough form finish.
- D. Smooth Plastic Liner Finish: Surface shall be smooth, concrete free of honeycombing, air pockets larger than 1/8 inch in diameter, and fins.
 1. This finish shall be used only where indicated on the Drawings.
- E. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- F. 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- G. Sacked Surfaces: Exposed surfaces that are unacceptable in appearance to the Architect shall be sacked.
 1. Prepare concrete surfaces in accordance with the referenced standards. Remove any form release materials by stoning by hand, power grinding or other method approved by the Architect.
 2. Prepare concrete surfaces to receive sack finishing with a light sand blasting.
 3. For best results, grout application and rubbing should be performed when areas to be treated are shaded and during cool, damp weather. When work is to be performed in hot and dry weather, a fog spray should be available for continuous use.
 4. Prepare grout samples for matching of concrete surfaces for approval by the Architect. These shall be made in the following proportions of gray cement to white cement to sand: 1:1:2, 1:2:3, and 2:1:3, etc. until the correct matching color is obtained on the test areas. Sand should be fine enough to pass the Number 30 sieve. Mixes should be made to a good workable consistency in a clean container and the mix with the best color chosen, or modified if needed.
 5. Provide sufficient quantities of sand and cement from the same source for the complete work at the job site.
 6. Mixing Application:
 - a. Mixing of grout on the job should be timed for it to be used up within 1 to 1-1/2 hours.
 - b. Let the grout stand 20 to 30 minutes after mixing, and then remixed before applying.
 - c. Soak the concrete surface thoroughly with water at least 15 minutes before applying grout and again just before application so that the surface is adequately wet during the operation.

- d. Apply grout with plasterer's trowel or sponge rubber float in sweeping strokes from the bottom up. Brush or spray gun applications may be used when approved by the Architect.
 - e. Work in freshly applied grout vigorously with a sponge rubber float, then let sit until some of its plasticity is gone but not until it loses its damp appearance. At this point it shall be rubbed with clean, dry burlap to remove the excess grout, leaving no visible film on the surface but filling all air holes.
 - f. Keep the surface wet for a day after grouting and sack rubbing are completed.
- 7. Alternate methods of application and materials shall be subject to the approval of the Architect.
- H. Schedule of Concrete Finish Types shall be coordinated with the Architect and indicated on Drawings.

3.08 FINISHING FLOORS AND SLABS (FLATWORK)

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Unless otherwise indicated or specified, flatwork shall have an integral monolithic finish.
- C. Integral Monolithic Finish: Apply as soon as freshly poured concrete slabs will bear weight of workers. Pour slabs full thickness to finish floor elevations indicated. At proper time, tamp surface repeatedly with a wire mesh or grid tamper in a manner to force aggregate down below surface and to bring sufficient mortar to surface to provide for a smooth coating of cement mortar over entire surface. Allow surface mortar to partially set, then float with wooden floats and finish with one of following, as required.
 - 1. Broom Finish: Steel trowel surface to a smooth dense surface free of lines, tool marks, cat faces and other imperfections. After troweling, and before final set, give surface a broom finish, brushing in direction noted on Drawings, or as directed. Broom finish shall be used typically on exterior flatwork except as otherwise indicated or specified and shall be "medium" texture as approved by Architect.
 - 2. Smooth Steel Trowel Finish: Apply 2 steel trowelings to obtain hard, smooth surface. All lips, irregularities, uneven levels, etc. shall be worked out before last troweling. All interior flatwork shall have a smooth steel trowel finish unless specified otherwise.
- D. Slip-Resistive Finish: Before final floating, apply slip-resistive finish. Apply according to manufacturer's written instructions.
- E. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions.

3.09 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. For tolerances not indicated, refer to ACI 117.
- B. Slabs on grade – Comply with FF Floor Flatness & FL Floor Levelness as specified by Architect or Structural Engineer. Where not otherwise indicated, slab shall meet the a Specified overall flatness, $SOFF = 35$ and Specified overall levelness, $SOLF = 25$ minimum. Coordinate with Architect flatness and levelness requirements for flooring to be installed prior to placing concrete.
- C. Elevated slabs – Comply with Architectural or Structural Engineer requirements.
- D. Comply with flatness and levelness tolerances per ASTM E 1155 for randomly trafficked floor surfaces. Measure FF Floor Flatness and FL Floor Levelness within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- E. Slabs supporting modular office partitions, adhered flooring systems, or compact storage shelving must also comply with the manufacturer's tolerance requirements.

- F. Slabs scheduled to receive wood flooring must also comply with tolerances required for installation of wood flooring.
- G. Finished surfaces of exterior integral finished flatwork shall not vary more than 1/4 inch from a 10' long straightedge, except at grade changes.
- H. Fill or grind completed slabs as necessary to achieve specified finish tolerances. Fill shall be with a self-leveling cementitious product capable of being tapered to a feathered edge.
 - 1. Repair any slab section measuring below either the minimum local F-number or the minimum local L-number.

3.10 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
 - 2. As a minimum, shoring shall remain in place for the following periods:
 - a. Walls and Columns: 2 days
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.11 CONCRETE SURFACE REPAIRS

- A. Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Repair and replacement work will be done at Contractor's expense.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Slabs on Grade: After entire slab is finished, shrinkage cracks that may appear shall be patched as follows:
 - 1. Where slab is not exposed or where appearance is not important, cracks larger than 1/32 inch wide shall be filled with cement grout and struck off level with surface.
 - 2. Where slab is exposed and appearance is important, unsightly cracks shall be repaired in a manner satisfactory in appearance to Architect. If this cannot be accomplished, concrete shall be considered defective.
- D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Honeycombed areas shall be removed down to sound concrete, coated with a bonding grout or approved compound and patched using a low shrinkage high bond mortar. Patched areas shall be cured by being kept damp for at least 5 days.
 - 3. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before

- proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
4. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- G. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing. Concrete shall be maintained at not less than 50 degrees F nor more than 100 degrees F for a period of 72 hours after being deposited.
- B. Protection: Contractor shall be responsible for protection of finished concrete against injury by rain, cold, vibration, animal tracks, marking by visitors, vandalism, etc.
- C. Provide additional curing agents or compounds, not necessarily listed herein, but as recommended and or required for use with shake type hardeners or other special coatings and coverings by their manufacturers for a complete and proper installation.
- D. Where supplementary cementitious materials are used, extra precautions shall be taken to prevent premature drying.

- E. Evaporation Retarder: Apply evaporation retarder to unformed 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.
- F. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period. Forms heated by sun shall be kept moist during curing period.
- G. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- H. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) 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 not less than seven (7) days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply 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.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
 - 5. Interior slabs to receive adhesive-applied or resilient flooring: Cure only with moisture retaining cover. Do not cure with curing compound.
 - 6. Interior slabs to receive thin set of tile: Cure only with moisture retaining cover. Do not cure with curing compound.
- I. Flatwork: Flatwork to be exposed, stained, or painted shall have curing process submitted and approved by the architect prior to construction.
 - 1. Initial Curing Process:
 - a. Mist Spraying: As soon as troweling of concrete surfaces is completed, exposed concrete shall be sprayed continuously with a special atomizer spray nozzle, capable of producing a fine mist. Spraying shall be done without any dripping of water from nozzle. Amount of spraying shall be such as to maintain surface of concrete moist

without any water accumulating on surface. Maintain spraying for a minimum of 12 hours, or until such time as hereinafter described curing process is applied. Mist spraying will not normally be required when the ambient air temperature is below 90 degrees F.

2. Final Curing Process:

- a. Water Curing: Concrete shall be kept wet by mechanical sprinklers or by any other approved method which will keep surfaces continuously wet.
 - b. Saturated Burlap Curing: Finished surfaces shall be covered with a minimum of two layers of heavy burlap which shall be kept saturated during the curing period.
 - c. Curing Compounds: Membrane curing compounds of chlorinated rubber or resin type conforming to ASTM C309 may be used only if specifically approved by Architect. Use of membrane curing compound will not be permitted on surfaces to be painted, or to receive ceramic tile, membrane water-proofing or hardeners and sealers. Membrane curing compound may be used in areas to receive resilient floor tile, provided it is wax-free, compatible with adhesive used and approved by adhesive manufacturer. Agitate curing compounds thoroughly by mechanical means continuously during use and spray or brush uniformly in accordance with manufacturer's recommendations. Apply immediately following final finishing operation. All curing compounds shall conform to State of California Air Resources Board VOC Regulations.
 - d. Waterproof paper conforming to ASTM C 171, or opaque polyethylene film, may be used. Concrete shall be covered immediately following final finishing operation. Anchor paper or film securely and seal all edges in such a manner as to prevent moisture escaping from concrete.
- J. Refer to Drawings for areas of concrete slab not to receive curing compounds or hardening compounds. Where concrete floors are to receive heavy duty coatings, waterproof coatings and the like, verify with coating installer the type of finish required for specified coating.

3.13 SURFACE HARDENER AND SEALER

- A. Seal all interior exposed flatwork with clear sealer, except surfaces receiving ceramic tile, quarry tile, poured flooring or other special finishes specified, or as scheduled on the Drawings.
 1. Apply sealer in 2 or 3 coats, in accordance with manufacturer's directions, using the maximum quantity recommended.
 - a. Concrete floors must be thoroughly cured for a minimum of 30 days and completely dry before treatment.
 - b. Surfaces to be treated must be clean, free of membrane curing compounds, dust, oil, grease and other foreign matter.
 - c. Upon completion, concrete surfaces shall be clean and without discoloration or traces of excess hardener left on the surface.
- B. Apply sprayable hardener/sealer at locations as scheduled or as indicated on the Drawings. Apply in accordance with the manufacturer's favorably reviewed application instructions and recommendations.

3.14 GROUTING

- A. Prepare and place grout materials at locations as indicated on the Drawings in accordance with the manufacturer's recommendations and installation instructions.
- B. Pack grout materials solidly between bearing surfaces and bases or plates as indicated and to ensure no voids.

3.15 DEFECTIVE CONCRETE

- A. Defective concrete shall mean any of the following:
 - 1. Concrete not meeting 100 percent of the specified 28 day compressive strength.
 - 2. Concrete exhibiting rock pockets, voids, spalls, streaks, cracks, honeycombing, that has any sawdust, wood, or debris embedded in it, or is otherwise defective, and in the Architect's judgment these defects impair the proper strength or appearance of the work
 - 3. Exposed reinforcing to extent that strength, durability, or appearance is adversely affected.
 - 4. Concrete significantly out of place, line, or level.
 - 5. Concrete not containing the required embedded items.
 - 6. Any concrete work not in accordance with the Specification and Drawings.
- B. Upon determination that concrete strength is defective:
 - 1. Should cylinder tests fall below minimum strength specified, concrete mix for remainder of work shall be adjusted to produce required strength. Core samples shall be taken and tested from cast-in-place concrete where cylinders and samples indicate inferior concrete with less than minimum specified strength.
 - a. Cores of hardened concrete shall be taken and tested in accordance with ASTM C 42 and C 39. Number and location of such cores shall be subject to the approval of Architect.
 - b. Cost of core sampling and testing will be paid for by the Contractor.
 - c. "85 percent" reduction in ACI 318 Section 26.12.4 will not justify low cylinder tests.
- C. Upon determining that concrete surface is defective, Contractor may restore concrete to acceptable condition by cutting, chipping, pointing, patching, grinding, if this can be done without significantly altering strength of structure. Permission to patch defective areas will not be considered a waiver of the right to require removal if patching does not, in the opinion of the Architect, satisfactorily restore quality and appearance.
- D. If core tests indicate that concrete is below the strength specified, or if patching does not restore concrete to specified quality and appearance, the concrete shall be deemed defective, and shall be removed and replaced without additional cost to the Owner.
- E. No repair work shall begin until the procedure has been reviewed by the Architect and Structural Engineer.

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.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Post-installed concrete anchors, per ICC-ES or IAPMO recommendations.
 - 5. Verification of use of required design mixture.
 - 6. Concrete placement, including conveying and depositing.
 - 7. Curing procedures and maintenance of curing temperature.
 - 8. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Provide special inspections and testing as described in the "Statement of Structural Special Inspections and Testing" within the structural drawings and as required by this section.
 - 1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of

building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.

2. The following tests shall be made by a recognized testing laboratory selected by the Owner and approved by the governing agency. All tests shall be in accordance with the previously mentioned standards and ACI 318 Section 26.12. A complete record of all tests and inspections shall be kept per CBC Section 1903A.1.
 - a. Compressive Strength: Make and cure in accordance with ASTM C31. Test in accordance with ASTM C39 and ACI 318 Section 26.12.
 - 1) A record shall be made of time and of locations of concrete from which samples were taken.
 - 2) Four identical cylinders shall be taken from each pour of 150 cubic yards or 5000 square feet or part thereof, being placed each day per ACI 318 Section 26.12.2. One cylinder shall be tested at age 7 days, and two at age 28 days unless otherwise specified. Preserve remaining cylinder for future use.
 - b. Drying Shrinkage: (applies to lightweight concrete only unless noted otherwise).
 - 1) A record shall be made of time cylinders and of locations of concrete from which samples were taken.
 - 2) Three identical 4" x 4" x 11" specimens shall be made from same concrete as used in structure. Percent of shrinkage shall be reported at 21 days after 7 day moist curing period. Average results of 3 specimens shall be used as the accepted value. The value for laboratory cast specimens shall not exceed .075%. If field test specimens are used in lieu of laboratory specimens, a tolerance of +33% may be used.
 - 3) Test specimens in accordance with ASTM C157.
 - c. Concrete consistency (slump) shall be tested in accordance with ASTM C143. Perform one slump test for each set of test cylinders taken.
 3. Provide full time inspection per CBC Section 1704A.3 during the taking of test specimens and during the placing of all concrete and embedded steel.
 4. Provide concrete batch plant inspections per ASTM C685.
- D. Reinforcing Steel
1. See Section 03 20 00.
- E. Survey and Adjustment: Continuously observe formwork operations, record such observations on a daily basis, and submit reports of the results. Instrument check forms before and during concrete placement to assure no movement has taken place. Make appropriate corrections to reposition displaced forms.
1. Measure floor and slab flatness and levelness as specified in "Floor Flatness and Levelness Tolerances" Section.
 2. Certify, by written report submitted on a weekly basis, for each level and story that the elevations, finish lines and building lines of the hardened concrete are within tolerances, as substantiated by transit survey; also that all embeds and inserts have been installed within tolerance.
- F. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.
- G. Permeability Test: Test concrete with waterproofing admixture according to COE CRD-C 48.

3.17 ADJUSTING AND CLEANING

- A. Remove all debris, excess materials, tools and equipment resulting from or used in this operation at completion of this work.
- B. Surfaces to be painted shall be smooth and free of substances such as dirt, wax, excessive laitance, grease or materials that would prevent proper bonding of finishes.

1. Removal of foregoing contaminants, and complete removal of parting and curing compounds affecting proper paint bond, shall be responsibility of this Section of Work. Sandblast cleaning shall not be employed without specific approval of Structural Engineer.

END OF SECTION

SECTION 033300
ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete that apply to architectural concrete.

1.2 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Concrete that is exposed to view, is designated as architectural concrete, and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance, including, but not limited to the following.
1. Concrete bench seating
 2. Concrete walks
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials 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 concrete.
- D. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Form-facing panels.
2. Form joint sealant.
3. Portland cement.

1.4 QUALITY ASSURANCE

- A. Ready-Mixed Concrete 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 certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - B. Installer Qualifications: An experienced cast-in-place architectural concrete installer, as evidenced by not less than five consecutive years' experience, specializing in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 1. Provide written evidence of qualifications and experience.
 2. Include locations, descriptions, and photographs of completed projects, including name of architect, substantiating the quality of the installer's experience.
 - C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Technical Manager.
 1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level I.
 2. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Level II.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Comply with ASTM C94/C94M and ACI 301.
- 1.6 FIELD CONDITIONS
- A. Cold-Weather Placement: Comply with Section 033000 "Cast-in-Place Concrete."
 - B. Hot-Weather Placement: Comply with Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials:
 1. Portland Cement: As specified in Section 033000, "Cast-in-Place Concrete"
- B. Normal-Weight Aggregates: As specified in Section 033000, "Cast-in-Place Concrete"

1. Maximum Coarse-Aggregate Size: 1/2 inch.
 2. Gradation: Uniformly graded.
- C. Air-Entraining Admixture: As specified in Section 033000 "Cast-in-Place Concrete."
- D. Chemical Admixtures: As specified in Section 033000 "Cast-in-Place Concrete," and certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
- E. Water and Water Used to Make Ice: As specified in Section 033000, "Cast-in-Place Concrete".

2.3 CURING MATERIALS

- A. Comply with Section 0330000 "Cast-in-Place Concrete."
1. For integrally colored concrete, curing materials to be approved by color pigment manufacturer.
 2. For concrete indicated to be sealed, curing materials to be compatible with sealer.

2.4 REPAIR MATERIALS

- A. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C881/C881M two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements.

2.5 CONCRETE MIXTURES, GENERAL

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs, based on laboratory trial mixtures.
- C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. As specified in Section 033000, "Cast-in-Place Concrete".

- D. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.6 CONCRETE MIXTURES

A. Class:

1. Normal-Weight Concrete: K.
2. Exposure Class: As specified in Section 033000, "Cast-in-Place Concrete".
3. Minimum Compressive Strength: As specified in Section 033000, "Cast-in-Place Concrete".
4. Slump Limit: As specified in Section 033000, "Cast-in-Place Concrete".
5. Air Content:
 - a. As specified in Section 033000, "Cast-in-Place Concrete".
6. Limit water-soluble, chloride-ion content in hardened concrete as specified in Section 033000, "Cast-in-Place Concrete".

2.7 CONCRETE MIXING

A. Architectural Concrete:

1. Ready mixed. Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish batch ticket information.
 - a. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 - b. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - c. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - d. 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

3.1 INSTALLATION OF FORMWORK

- A. Comply with Section 031000 "Concrete Forming and Accessories" for formwork, embedded items, and shoring and reshoring, and as specified in this Section.
- B. Limit deflection of form-facing panels to not exceed ACI 301 requirements.
- C. Limit cast-in-place architectural concrete surface irregularities, as follows:

1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
- D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117.
- E. Seal form joints, chamfers, rustication joints, and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 1. Provide closure backing materials if indented rustication is used over a ribbed form line, and seal joint between rustication strip and form with joint sealant.
- F. Tool exterior corners and edges of cast-in-place architectural concrete, as follows.
 1. Bench: 1 inch radius at corners
 2. Walks: See Section 311315 "Site Concrete Improvements"
- G. Coat contact surfaces of wood rustications and chamfer strips with wood sealer before placing reinforcement, anchoring devices, and embedded items.
- H. Coat contact surfaces of forms with form-release agent, in accordance with manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

3.2 INSTALLATION OF REINFORCEMENT AND ACCESSORIES

- A. Comply with Section 032000 "Concrete Reinforcing" for fabricating and installing steel reinforcement and accessories.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, 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 24 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 approved field sample panels.
- B. Clean and repair surfaces of forms to be reused in the Work.
 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

- A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, 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.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete. Align construction joint within rustications attached to form-facing material.
 - 3. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at top of footings or floor slabs.
 - 5. Space vertical joints in benches equally spaced and 48 inch maximum. Unless otherwise indicated on Drawings, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use bonding agent As specified in Section 033000, "Cast-in-Place Concrete".
- B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

3.5 CONCRETE PLACEMENT

- A. Comply with Section 033000 "Cast-in-Place Concrete."

3.6 FINISHING FORMED SURFACES

- A. Comply with Section 033000 "Cast-in-Place Concrete."
- B. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- C. As-Cast Surface Finishes: Comply with Section 033000 "Cast-in-Place Concrete" for the following:
 - 1. ACI 301 Surface Finish-1.0 (SF-1.0).
- D. Final Concrete Finish: Comply with Section 033000 "Cast-in-Place Concrete" for the following:
 - 1. Smooth-rubbed finish.
 - a. Benches
 - b. Pedestals
 - 2. Broom finish

a. walks

- E. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.
- F. Maintain uniformity of architectural concrete finishes over construction joints unless otherwise indicated.

3.7 CONCRETE CURING

- A. Comply with Section 033000 "Cast-in-Place Concrete"

3.8 REPAIR

- A. Comply with ACI 301.
- B. Repair damaged finished surfaces of cast-in-place architectural concrete when repairing is approved by Architect.
- C. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved field sample panels.
- D. Remove and replace cast-in-place architectural concrete that cannot be repaired to Architect's approval.

3.9 FIELD QUALITY CONTROL

- A. Comply with Section 033000 "Cast-in-Place Concrete."

3.10 CLEANING

- A. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- B. Wash and rinse surfaces in accordance with concrete finish applicator's written instructions.
 - 1. Protect other Work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

3.11 PROTECTION

- A. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- B. Protect cast-in-place architectural concrete from staining, laitance, and contamination

during remainder of construction period.

3.12 FINAL ACCEPTANCE

- A. Final acceptance of completed architectural concrete Work will be determined by Architect by comparing approved field sample panels with installed Work, when viewed at a distance of 5 feet.

END OF SECTION

SECTION 040513
MASONRY MORTARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Mortar for masonry.

1.3 RELATED REQUIREMENTS

- A. Section 04 05 16 – Masonry Grouting.
- B. Section 04 22 00 – Concrete Unit Masonry

1.4 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the “Design Criteria Notes” in the structural drawings. If not listed in the “Design Criteria Notes”, use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
 - 2. ASTM C91 - Standard Specification for Masonry Cement.
 - 3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 4. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 5. ASTM C150 - Standard Specification for Portland Cement.
 - 6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 7. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 8. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 9. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
 - 10. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength.
 - 11. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
 - 12. ASTM C1714 - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.
 - 13. ASTM E518 - Standard Test Methods for Flexural Bond Strength of Masonry.

14. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- D. Reports: Submit reports on mortar indicating compliance of mortar to property requirements of ASTM C270 and test and evaluation reports per ASTM C780.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Submit documentation on all materials including but not limited to:
 1. Aggregates.
 2. Cement.
 3. Admixtures.

1.6 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 1. Maintain one copy of each on the Project site.

1.7 PRECONSTRUCTION TESTING

- A. A testing program is required prior to start of construction. Testing program to be done in Compliance with the current building design code requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
- B. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 40 00 - Quality Requirements.
- C. Sample panel construction: For masonry governed by Level 2 or 3 Quality Assurance, construct sample panels of masonry walls per TMS 602 Article 1.6 D. The specifier has the option of permitting a segment of the masonry construction to serve as a sample panel or requiring a separate stand-alone panel.
- D. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.

1. Test results will be used to establish optimum mortar proportions and establish quality control values for construction testing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.9 FIELD CONDITIONS

- A. Cold Weather Construction to be in accordance with TMS 602.
- B. Hot Weather Construction to be in accordance with TMS 602.

PART 2 - PRODUCTS

2.1 MORTAR APPLICATIONS

- A. At Contractor's option, mortar may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Mortar Color: Natural gray unless otherwise indicated.
- C. Mortar Mix Designs: ASTM C270, Property Specification.
 1. Structural Load Bearing and Shear Walls: Type S.
 2. Mortar shall be made with admixtures that are proportioned, added and mixed in strict accordance with manufacturer's directions. Calcium Chloride cannot be used in mortar mixes.

2.2 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714 and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
- B. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, graded sand, and chemical admixtures complying with ASTM C91 with the addition of water only.
 1. Color: As indicated in the Drawings.
- C. Portland Cement: ASTM C150, Type I or II, low alkali; natural gray.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Quicklime: ASTM C5, non-hydraulic type.

- F. Mortar Aggregate: ASTM C144.
- G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979.
 - 1. Color(s): As selected by Architect from manufacturer's full range.
- H. Water: Clean and potable.
- I. Bonding Agent: Latex type.
- J. Integral Water-Repellent and Efflorescence-Control Admixture: Polymeric liquid admixture added to mortar at the time of manufacture.
 - 1. Performance of Mortar with Integral Water Repellent:
 - a. Water Permeance: When tested per ASTM E514 and for a minimum of 72 hours:
 - 1) No water visible on back of wall above flashing at the end of 24 hours.
 - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - 2. Use only in combination with masonry units produced with integral water-repellent admixture.
 - 3. Product: Master Builders MasterPel 240MA.

2.3 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Mix mortar in accordance with TMS 602 Articles 2.6A and 2.6B.
- C. Accurately measure materials in suitably calibrated devices; shovel measurements are not acceptable.
- D. Maintain sand uniformly damp immediately before the mixing process.
- E. Place sand, cement and water in mixer in that order and mix for at least 2 minutes; then add lime putty and continue mixing as long as necessary to secure a uniform mass, but in no case less than 10 minutes.

- F. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio; mix in accordance with manufacturer's instructions, uniform in coloration.
- G. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- H. Do not use anti-freeze compounds to lower the freezing point of mortar.
- I. If water is lost by evaporation, re-temper only within two hours of mixing. Retempering by dashing water over mortar will not be permitted.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Apply bonding agent to existing concrete surfaces.

3.2 INSTALLATION

- A. Install mortar to requirements of section(s) in which masonry is specified.
- B. Remove excess mortar from grout spaces.

3.3 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 40 00 - Quality Requirements.
- B. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314, and for flexural bond strength in accordance with ASTM C1072 or ASTM E518; perform tests and evaluate results as specified in individual masonry sections.

3.4 DEFECTIVE MORTAR

- A. Should the strength of mortar fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior mortar and indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.
- B. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to Owner.
- C. Costs relative to taking and testing of core samples shall be paid by Owner and will be deducted from Contract Amount. Cost of patching core holes shall be borne by Contractor.

END OF SECTION

SECTION 040516
MASONRY GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Grout for masonry.

1.3 RELATED REQUIREMENTS

- A. Section 04 05 13 – Masonry Mortaring.
- B. Section 04 22 00 – Concrete Unit Masonry

1.4 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the “Design Criteria Notes” in the structural drawings. If not listed in the “Design Criteria Notes”, use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
 - 2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 - 5. ASTM C476 - Standard Specification for Grout for Masonry.
 - 6. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 7. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
 - 8. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry.
 - 9. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength.
 - 10. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
 - 11. ASTM E518 - Standard Test Methods for Flexural Bond Strength of Masonry.
 - 12. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data:
 - 1. Include mix design.
 - 2. Include required environmental conditions and admixture limitations.
- C. Reports: Submit reports on grout indicating compliance of component grout materials to requirements of ASTM C476 and test and evaluation reports to requirements of ASTM C1019.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Submit documentation on all materials including but not limited to:
 - 1. Aggregates.
 - 2. Cement.
 - 3. Admixtures.
- E. Manufacturer's Installation Instructions: Submit packaged dry mortar manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each on the Project site.

1.7 PRECONSTRUCTION TESTING

- A. A testing program is required prior to start of construction. Testing program to be done in Compliance with the current building design code requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
- B. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 40 00 - Quality Requirements.
- C. Sample panel construction: For masonry governed by Level 2 or 3 Quality Assurance, construct sample panels of masonry walls per TMS 602. The specifier has the option of permitting a segment of the masonry construction to serve as a sample panel or requiring a separate stand-alone panel.
- D. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.
 - 1. Test results will be used to establish optimum grout proportions and establish quality control values for construction testing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.9 FIELD CONDITIONS

- A. Cold Weather Construction to be in accordance with TMS 602.
- B. Hot Weather Construction to be in accordance with TMS 602.

PART 2 - PRODUCTS

2.1 GROUT APPLICATIONS

- A. At Contractor's option, grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
- B. Grout Mix Designs:
 - 1. Provide premixed type in accordance with ASTM C476.
 - 2. Grout shall have a 28-day compressive strength of 2000 psi or f'm as indicated in the Drawings, whichever is greater. Grout shall conform to TMS 602.
 - 3. Coarse Grout: The contractor is to coordinate the proper grout pour height used with the clear grout space width for multi-wythe construction or clear grout space dimensions for hollow units in accordance with TMS 402 Table 3.2.1.
 - 4. Add grout admixture in accordance with the manufacturer's recommendations. Calcium Chloride cannot be used in grout mixes.

2.2 MATERIALS

- A. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
 - 1. Type: Coarse.
- B. Portland Cement: ASTM C150, Type I or II, low alkali; natural gray.
- C. Quicklime: ASTM C5, non-hydraulic type.
- D. Grout Aggregate: ASTM C404.
- E. Water: Clean and potable.
- F. Water-Reducing Admixture: expanding, retarding, and water-reducing.
 - 1. Product: Sika Grout Aid.
- G. Bonding Agent: Latex type.
- H. Integral Water-Repellent and Efflorescence-Control Admixture: Polymeric liquid admixture added to grout at the time of manufacture.
 - 1. Use only in combination with masonry units produced with integral water-repellent admixture.

2. Product: Master Builders MasterPel 240MA.
- I. Bond Beam Mesh: Barrier to stop grout when filling block wall cells
 1. Manufacturers:
 - a. Grout Stop: www.wirebond.com/products/grout-stop
 - b. Mortar/Grout Screen: www.h-b.com
 - c. Mortar Mesh: www.bontool.com/mortar-mesh-100-x-4-81-118

2.3 GROUT MIXING

- A. Mix grout in accordance with ASTM C476.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for coarse grout.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- D. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Apply bonding agent to existing concrete surfaces.
- B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

3.2 INSTALLATION

- A. Install grout to requirements of section(s) in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without reconsolidating.
- D. Do not displace reinforcement while placing grout.

3.3 GROUTING

- A. General Requirements:
 1. All cells shall be grouted solid as indicated on the Drawings.
 2. Use of grout lifts above or below 4'-0" for 8 inch nominal hollow unit masonry or 5'-4" for 10 inch nominal or wider hollow unit masonry at Contractor's option.
 3. Use grout pump, hopper or bucket to place grout.
 4. Place grout in final position within 1 1/2 hours after introduction of mixing water.
 5. Stop grout approximately 1½ inches below top of last course; except at top course bring grout to top of wall, unless noted otherwise on drawings. Do not form grout keys within beams.
- B. Grout pours less than 4'-0" for 8 inch nominal hollow unit masonry or 5'-4" for 10 inch nominal or wider hollow unit masonry:

1. Do not lay units higher than 4'-0" before grouting for 8 inch nominal hollow unit masonry or 5'-4" for 10 inch nominal or wider hollow unit masonry.
 2. If mortar has been allowed to set prior to grouting, remove all fins protruding more than ¼ inch into grout space.
 3. Conform to requirements of CBC Section 2104A.1.3.5.1.
 4. Consolidate each lift with mechanical vibration twice per Article 3.5 E of TMS 602. Once while placing grout and once more after initial absorption of water but before set.
- C. Grout pours greater than 4'-0" for 8 inch nominal hollow unit masonry or 5'-4" for 10 inch nominal or wider hollow unit masonry:
1. Conform to requirements of TMS 602 and CBC Section 2104A.1.3.5.2. Grouting procedure shall be submitted and subject to approval by DSA.
 2. Layup walls, subject to maximum height limitations of Table 6 under Article 3.5 of TMS 602.
 3. Provide clean out holes at the bottom of every pour in cells containing vertical reinforcement. Construct clean out courses with double open-end bond beam units inverted to permit cleaning of all cells by flushing. Cleanouts shall be not less than 3x4 inch openings cut from one face shell. Do not plug clean out holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected.
 4. Clean mortar droppings from the bottom of the grout space and from reinforcing steel. Remove mortar fins protruding more than ¼ inch into the grout space by dislodging the projections with a rod or stick as the work progresses or by washing the grout space at least twice a day during erection using a high-pressure stream of water.

3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 40 00 - Quality Requirements.
- B. Test and evaluate grout in accordance with ASTM C1019 procedures.
 1. Test with same frequency as specified for masonry units.

3.5 DEFECTIVE GROUT

- A. Should the strength of grout fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior grout and indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.
- B. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to Owner.
- C. Costs relative to taking and testing of core samples shall be paid by Owner and will be deducted from Contract Amount. Cost of patching core holes shall be borne by Contractor.

END OF SECTION

SECTION 042200
CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Concrete block.
- B. Reinforcement.
- C. Bolts and Post-Installed Anchors.
- D. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 03 30 00 - Cast-in-Place Concrete.
- D. Section 04 05 13 - Masonry Mortaring.
- E. Section 04 05 16 – Masonry Grouting.
- F. Section 05 50 00 - Metal Fabrications.
- G. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the “Design Criteria Notes” in the structural drawings. If not listed in the “Design Criteria Notes”, use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 - 3. ASTM A580 - Standard Specification for Stainless Steel Wire.
 - 4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 5. ASTM A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

6. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
8. ASTM A951 - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
9. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
10. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
11. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
12. ASTM C150 - Standard Specification for Portland Cement.
13. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
14. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
15. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
16. ASTM E514 - Standard Test Method for Water Penetration and Leakage Through Masonry.
17. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners.
- D. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
- E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture where utilized.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.

- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

- 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each on the Project site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 MOCK-UPS

- A. Sample panel construction: For masonry governed by Level 2 or 3 Quality Assurance, construct sample panels of masonry walls per TMS 602. The specifier has the option of permitting a segment of the masonry construction to serve as a sample panel or requiring a separate stand-alone panel.
- B. Locate where directed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture.
- C. Store masonry accessories, including metal items, in such a way as to prevent corrosion or accumulation of dirt and oil.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: 8" wide by 8" high x 16" long unless as otherwise indicated on the Drawings.

2. Special Shapes: Provide bond beam units, open end units, lintel units and other special units as indicated. Use open end units at cells containing vertical reinforcement wherever possible.
3. Load-Bearing Units: ASTM C90.
 - a. Weight: As indicated in the Drawings.
 - b. Hollow block, as indicated in the Drawings.
 - c. Exposed Faces: Manufacturer's standard color and texture where indicated in the Drawings.
 - d. Exposed Faces: Special color and texture where indicated in the Drawings.
4. Pre-Faced Units: ASTM C90, hollow block, with smooth resinous facing complying with ASTM C744.
 - a. Colors and styles: As indicated on the Drawings.
 - 1) Substitutions: See Section 01 60 00 - Product Requirements.
5. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
 - a. Performance of Units with Integral Water Repellent:
 - 1) Water Permeance: When tested per ASTM E514 and for a minimum of 72 hours.
 - (a) No water visible on back of wall above flashing at the end of 24 hours.
 - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
 - (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
 - 2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
 - 3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
 - b. Use only in combination with mortar that also has integral water repellent admixture.
 - c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

2.2 REINFORCEMENT

- A. Reinforcing Steel: Type as specified in Section 03 20 00; size as indicated on the Drawings.
- B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

C. Single Wythe Joint Reinforcement: ASTM A951.

1. Type: Truss or ladder.
2. Material: ASTM A1064 steel wire, mill galvanized to ASTM A641 Class 3.
3. Size: 9 gauge (0.1483 inch) side rods with 9 gauge (0.1483 inch) cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure and minimum 2 inches less than the nominal width of walls.
4. Cross-rods are to be butt welded to side rods. Cross-rods to be spaced 16 inches on center.

2.3 BOLTS AND POST-INSTALLED ANCHORS

A. Anchor Bolts:

1. As indicated on the Drawings.

B. Expansion Anchors:

1. As indicated on the Drawings.

C. Adhesive Anchors:

1. As indicated on the Drawings.

D. Screw Anchors:

1. As indicated on the Drawings.

E. Anchor Finish:

1. Interior Exposure: All anchors, nuts and washers for use in interior environments free of potential moisture shall be manufactured from carbon steel and zinc coated.
2. Exterior or Exposed Use: All anchors, nuts, and washers for use in exposed or potentially wet environments, or for attached of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors, nuts and washers shall conform to ASTM A153. Stainless steel anchors shall be manufactured from 300 series stainless steel. and nuts and washers from 300 series or Type 18-8 stainless steel.

2.4 ACCESSORIES

- A. Non-Metallic Expansion Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D1056, Grade RE 41E1, capable of compression up to 35% of width and thickness indicated.
- B. Premolded Control Joint Strips: Material as indicated below, designed to fit standard sash block and maintain lateral stability in masonry wall; size and configuration as indicated.

1. Premolded PVC Control Joint Strips. Strips shall be polyvinyl chloride complying with ASTM D 2287, Type PVC 654-4 with a durometer hardness or 90.
2. Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com.
 - b. Hohmann & Barnard, Inc: www.h-b.com.
 - c. WIRE-BOND: www.wirebond.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com.
 - b. WIRE-BOND: www.wirebond.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Drainage Fabric: Polyester or polypropylene mesh bonded to a water and vapor-permeable fabric.
 1. Manufacturers:
 - a. Advanced Building Products, Inc;
Mortairvent: www.advancedbuildingproducts.com.
 - b. Mortar Net Solutions; DriPlane: www.mortar.net.
 - c. York Manufacturing, Inc; Weep Armor Weep Vent
Protection: www.yorkmfg.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.5 JOINTS

- A. All joints to be tooled per Architectural Requirements.

2.6 SEALER

- A. Contractor shall provide and install minimum two coats, BASF MasterProtect H107 masonry sealer, or equal, at all CMU walls. BASF MasterProtect H107 product, or equal, shall meet all state vapor requirements. Sealer shall be clear and non-gloss product.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive masonry and verify following:

1. That foundation surface is level to permit bed joint with range of 1/4 inch minimum to 3/4 inch maximum for partially grouted or 1-1/4 inch maximum for fully grouted.
2. That edge is true to line to permit projection of masonry to less than 1/4 inch.
3. That projecting dowels are free from loose scale, dirt, concrete, or other bond inhibiting substances and properly spaced and located.
4. Do not begin work before unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean concrete surfaces to receive masonry. Remove laitance or other foreign material lodged in surfaces by sandblasting or other means as required. Joints between concrete and masonry shall be considered construction joints. See Concrete specifications.
- B. Ensure masonry units are clean and free from dust, dirt, or other foreign materials before laying. Do not use damaged masonry units, damaged components of structure, or damaged packaged materials.
- C. Establish lines, levels, and coursing. Protect from disturbances.
- D. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- E. Direct and coordinate placement of metal anchors supplied for installation under other sections.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Cold Weather Construction to be in accordance with TMS 602.
- B. Hot Weather Construction to be in accordance with TMS 602.

3.4 COURSING

- A. Place masonry to lines and levels indicated to the specified tolerances.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Preserve the vertical continuity of cells in concrete unit masonry per Article 3.3E of TMS 602.
- D. Concrete Masonry Units:
 1. Bond: Running, unless otherwise indicated on the Drawings.
 2. Coursing: One unit and one mortar joint to equal 8 inches, unless otherwise indicated on the Drawings.
 3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

- A. Do not install cracked, broken or chipped masonry units.
- B. Lay only dry concrete masonry units. Do not wet concrete masonry prior to laying up units unless written permission is obtained from the Engineer.
- C. Lay hollow masonry units with face shell bedding on head and bed joints.
 - 1. Block Cap: Lay with full mortar coverage on horizontal and vertical joints.
 - 2. Install grout cap where and as indicated.
- D. Fully bond intersections and external and internal corners.
- E. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- F. Remove excess mortar and mortar smears as work progresses.
- G. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- H. Interlock intersections and external corners, except for units laid in stack bond.
- I. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- J. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges. Install cut units with cut surfaces and, where possible, cut edges concealed.
- K. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- L. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- M. Step back unfinished work for joining with new work. Do not use toothing.
- N. Provide cleanouts as indicated in "grouting" below.
- O. Matching Existing Masonry Work: Match coursing, bonding, color and texture of new masonry work with existing work wherever possible.

3.6 JOINTS

- A. Horizontal and vertical joints at masonry units shall be 3/8 inch wide and as follows:
 - 1. Point joint tight in unpurged masonry below ground.
 - 2. All end joints shall be fully filled with mortar and joints squeezed in bed joints shall be held back approximately 1/2 inch from cell to provide positive bond with grout.

3. Joints shall be struck flush at all areas to receive plaster, stucco and any other finish material other than paint.

3.7 REINFORCEMENT

- A. Place reinforcement in accordance with TMS 602.
- B. Reinforcing steel shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the plans shall not be used. Heating of bars for bending is not permitted.
 1. Bars shall conform accurately to the sizes, shapes, lines and dimensions shown on drawings and with hooks and beds made as detailed. Bars shall be placed as indicated on the Drawings.
 2. At the time grout is place around it, reinforcing steel shall be clean of mill scale or other coatings that will destroy or reduce bond.
- C. Foundation dowels that interfere with unit webs are permitted to be bent to a maximum of 1 inch horizontally for every 6 in of vertical height.
- D. Reinforcing steel shall be secured to all foundation dowels and held in place at spacing not to exceed 192 bar diameters.

3.8 GROUTING

- A. General Requirements:
 1. Refer to 04 05 16 Masonry Grouting.

3.9 CONTROL AND EXPANSION JOINTS

- A. See the Drawings for type and location of expansion and/or control joints.
- B. Where control joints are not indicated on the drawings the Contractor shall submit a proposed control joint layout for Architect and Engineer approval. General guidelines for control joint locations are as follows:
 1. At major changes in wall height.
 2. At changes in wall thicknesses.
 3. At corresponding control joints in foundations, floors, or roof construction.
 4. Near wall intersections.
 5. At column centerlines.
- C. Maximum Spacing: Maximum control joint spacing in concrete masonry construction shall be such that the ratio of wall length to height shall not exceed 1.5 with a maximum spacing of 25 feet.
- D. Form expansion joint as detailed on drawings.

3.10 BOND BEAMS

- A. Bond beams shall be located where shown and detailed on the drawings, and shall be reinforced as indicated and as herein after specified.

3.11 BUILT-IN WORK

- A. Miscellaneous Embedded Items: All items indicated to be embedded in masonry shall be carefully located and anchored to prevent movement during grouting operations. Solidly grout spaces around built-in items. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Install chases minimum of one full masonry unit length for jambs
- B. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- C. Install built-in items plumb, level, and true to line.
- D. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- E. Do not build into masonry construction organic materials that are subject to deterioration.

3.12 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Alignment of Columns: 1/4 inch.
- C. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.13 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.14 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140 for compliance with requirements of this specification.
- C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.15 REPAIR, POINTING, AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units.
- B. Pointing: During the tooling of joints, enlarge any voids or holes and completely fill with mortar.
- C. Dry brush masonry surface after mortar has set, at each day's work and after final pointing.
- D. Remove excess mortar and mortar droppings.
- E. Replace defective mortar. Match adjacent work.
- F. Clean soiled surfaces with cleaning solution.
- G. Use non-metallic tools in cleaning operations.
- H. Upon completion of masonry installation, repair all holes. Defective joints shall be cut out and rejointed. Exposed masonry surfaces shall be cleaned free of mortar, green stain and efflorescence.

3.16 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

3.17 DEFECTIVE MASONRY

- A. Materials or workmanship not conforming to appearance or strength specified, will be deemed defective and shall be removed and replaced at no cost to Owner.
- B. Defective mortar or grout, as defined under Section 04 05 13 and Section 04 05 16 shall constitute defective masonry.

END OF SECTION

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Structural steel framing members.
- B. Structural steel support members, plates, and bracing angles.
- C. Bolts, washers, and other steel accessories.
- D. Base plates, shear stud connectors and expansion joint plates.
- E. Grouting under base plates.
- F. Prime coat painting and touch up.
- G. Templates for cast-in-place anchor bolts.

1.3 RELATED REQUIREMENTS

- A. Section 05 21 00 - Steel Joist Framing.
- B. Section 05 50 00 - Metal Fabrications.
- C. Division 09 - "Paintings and Coatings" for surface-preparation and priming requirements.

1.4 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by American Institute of Steel Construction (AISC) 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Heavy Sections: Rolled and built-up sections as follows and subjected to special notch toughness, fabrication, welding and inspection requirements as defined in this specification:
 - 1. Shapes included in ASTM A6 with flanges thicker than 2 inches.

2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.
4. All ASTM A6 shapes with flange thickness greater than 1-1/2 inches that are part of the Seismic Force Resisting System.
5. Welded built-up members with plates thicker than 1-1/2 inches if part of the Seismic Force Resisting System.

1.5 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed Governing Building Code or material standard. If no specific edition is adopted, use the latest edition.

1. AISC 360 - Specification for Structural Steel Buildings
2. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
3. AISC 341 - Seismic Provisions for Structural Steel Buildings.
4. AISC 358 - Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
5. ASTM A36 - Standard Specification for Carbon Structural Steel.
6. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
7. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
8. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
9. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
10. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
11. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
12. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
13. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nut.
14. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
15. ASTM A913 - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process
16. ASTM A992 - Standard Specification for Structural Steel Shapes.
17. ASTM A1085 - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
18. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
19. ASTM E94 - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
20. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.
21. ASTM E165 - Standard Practice for Liquid Penetrant Testing for General Industry.

22. ASTM E709 - Standard Guide for Magnetic Particle Testing.
23. ASTM F436 - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
24. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
25. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
26. AWS D1.1 - Structural Welding Code.
27. AWS D1.8 - Structural Welding Code – Seismic Supplement.
28. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.
29. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
30. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).
31. SSPC-SP 1 - Solvent Cleaning.
32. SSPC-SP 2 - Hand Tool Cleaning.
33. SSPC-SP 3 - Power Tool Cleaning.
34. SSPC-SP 6 - Commercial Blast Cleaning.
35. UL (FRD) - Fire Resistance Directory Current Edition.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 1. Direct copies (including electronic versions) of SEOR plans and details are not allowed. Using SEOR plans as a background for the development of the submittal plans is acceptable.
 2. Submit shop drawings to Architect for review and obtain Architect's acceptance prior to start of fabrication. Where shop drawings are resubmitted, the Contractor shall cloud and identify all changes made due to additions, deletions, and corrections to the shop drawing. Shop drawings resubmitted without each change being clouded and identified will be returned for resubmission.
 3. Shop drawings shall include complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
 4. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.
 5. Include layout, member size, and weights, materials used, and beam marks as well as orientation and relation of members to appropriate grid lines and setting elevations for column bases. Reference shop drawings to specific location and detail number on the Structural Drawings.
 6. Include details of cuts, connections, splices, camber, holes, openings, doubler plates, stiffeners and other pertinent data, including bolt hole sizes, connection materials, and welded joint designations.
 7. Include embedment drawings.
 8. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 9. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.

10. Indicate surface preparation and finishes.
11. Submit plans of all levels locating the edge of slab at perimeter and at interior openings at locations where bent plate closure occurs.
12. Identify members and connections of the Seismic-Force-Resisting System (SFRS).
13. Indicate locations and dimensions of protected zones.
14. Identify welds that are part of the SFRS.
15. Identify Demand Critical Welds.
16. Shop drawings shall include connection details drawn to scale for members of the Seismic Force-Resisting System.
17. Dimensions required to locate structural steel for manufactured items such as mechanical equipment, electrical equipment, dock levelers, etc., shall be coordinated and provided by the General Contractor. General Contractor shall also coordinate and provide dimensions to locate structural steel for window washing supports such as davits, tie-backs, etc.
18. Connections required but not specifically referenced.

C. Erection Procedures:

1. Submit procedures, methods, sequences of erection, temporary shoring and guying, and equipment proposed for erecting structural steel. Erection procedures are submitted for record only and therefore will not be returned to the Contractor.

D. Bearing Assemblies:

1. Submit shop drawings and technical specifications for the slide bearing assemblies used in the project.

E. Jacking and Tensioning Procedures:

1. Submit procedures, methods, sequences of jacking and tensioning, instrumentation and monitoring devices if implemented within the project.

F. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," AWS D1.8, "Structural Welding Code – Seismic Supplement," and AISC 341 for each welded joint whether prequalified or qualified by testing, including items listed below. All submitted Procedures shall be reviewed by the Testing Agency prior to use on the project. The Procedures will be submitted to the Engineer for review after review by the testing agency is complete.

1. The WPSs and PQRs shall include all essential variables and parameters required by AWS D1.1 and AWS D1.8.
2. Where backgouging is required provide back gouging criteria (e.g. smoothness, grinding, gouge shape, inspection by the welder, etc.) per AISC 341, AWS D1.1, and AWS D1.8.
3. Explicitly note which WPSs will be used for welding of members and connections of the SFRS and Demand Critical Welds.
4. For multi-pass welds define sequence and layering of passes.

5. Welding Procedure Qualification Record (WPQR) Tests: For WPSs that are not pre-qualified per AWS D1.1, submit the supporting WPQR tests results conducted in accordance with AWS D1.1 along with the corresponding WPS.
 6. When the required effective throat thickness of flare groove welds is larger than allowed by Table J2.2 of AISC "Steel Construction Manual", submit data establishing by qualification the consistent production of such larger effective throat thickness. Qualification of effective throat thickness shall be as required by the AISC specification.
 7. For non-prequalified, complete butt or groove welds of the SFRS, include CVN weld test records.
 8. In addition to the WPS submit fabrication and erection procedures where needed to control shrinkage, fabrication tolerances, or to insure proper inspections.
 9. Include CVN tests, requirements and procedures in compliance with AWS D1.1, AWS D1.8 and the requirements of the contract documents. Test temperature shall be specified herein. Where specified CVN properties in the contract documents exceed the minimum requirements in AWS D1.1 / AWS D1.8, CVN tests shall be performed to the properties in the contract documents.
 10. All welds for the SFRS are according to AWS D1.8 as a minimum.
 11. WPS and WPQR's shall include specific reference to the manufacturer's make and model of weld material. Provide manufacturer's data sheet for all weld material indicating recommended welding parameters and variables.
- G. Weld Shrinkage and Distortion Procedures: Submit weld shrinkage and distortion procedures for all welded connections where distortion due to weld shrinkage may cause damage to the steel material. The welding sequence and procedures are to minimize the effect of weld shrinkage, residual stresses, and to maintain erection tolerances. These procedures shall be reviewed by Testing Agency, and then used by Testing Agency to verify conformance. As a minimum, procedures shall be submitted for the following connections:
1. Welding of continuity plates and doubler plates into the WF columns.
 2. Field welding beam-to-column connection (include beam flange welds, rib welds, connection plate bolting and weld).
 3. Welding columns to base plates.
- H. Fastener Installation Procedures: Submit written procedures for the pre-installation testing, installation snugging, pre-tensioning, and post-installation inspection of fasteners. The procedures shall meet all requirements of the Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using ASTM A325 or A490 Bolts" and the Contract Documents. Provide installation procedure and inspection for direct tension indicator washers detailed in supplemental specifications provided by the manufacturer for approval.
- I. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- J. Mill test reports for structural steel, including chemical and physical properties, regardless of thickness or use. Reports shall comply with ASTM A6 and be submitted to the Owner's Quality Assurance Agency.

1. Submit a mill report for each heat of steel used, and certified fastener reports for all fasteners, including nuts, washers and direct tension indicators prior to the start of fabrication. For unsatisfactory mill test report, retest steel.
 2. Include Charpy test results for heavy sections and for materials where Charpy values are specified. Testing required per AISC 360 section A3.1c and AISC 341 section A3.3 and as specified herein.
 3. Mill test reports shall include ladle analysis and tensile elongation.
 4. Mill reports shall be traceable to individual pieces of steel used.
 5. In addition to other requirements mill reports shall address the following elements: copper, columbium, chromium, nickel, molybdenum, silicone, and vanadium.
 6. Provide mill reports for all welding consumables used on this project.
- K. Fabricator Test Reports: Comply with ASTM A1011.
- L. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work. Submit to welding special inspector for approval. Submit final copies to Architect for review.
- M. General Contractor Verification of Compliance for Materials: General Contractor's review and acceptance shall be included with each submittal stating that the Contractor has reviewed the submitted manufacturer's test reports and certifications, and that the materials being furnished for the project are in conformance with the applicable standards and project documents. The review shall be submitted along with the manufacturer's test reports and certifications for structural steel, fasteners, welding filler metals, and shear studs.
- N. Product Test Reports and Certifications: Submit manufacturer's test reports and certifications as listed below. Test Reports and Certifications are submitted for record only and therefore will not be returned to the Contractor. A copy of the test reports and certifications shall be sent to the owners Quality Assurance Agency. The Contractor Certificate of Compliance letter shall accompany the Manufacturer's Certifications.
1. Bolts, nuts, and washers including mechanical properties and chemical analysis. Certifications for high strength bolts shall conform to certification requirements contained in ASTM A325, A490, F1852, F2280.
 2. Direct-tension indicators.
 3. Tension-control, high-strength bolt-nut-washer assemblies.
 4. Shear stud connectors. Shear studs, as supplied, shall meet the requirements of AWS D1.1, Sections 7.2 and 7.3.
 5. Shop primers.
 6. Nonshrink grout.
 7. Welding electrodes, fluxes and shielded gas products. Certifications shall satisfy the applicable AWS A5 and project requirements.
 8. Spray-on fireproofing. Submit certificate issued by paint manufacturer ensuring compatibility between the primer and the spray-on fireproofing.
- O. Submit fabricators identification mark system to Testing Agency prior to fabrication.
- P. Fabricator's Qualification Statement.

- Q. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- R. As-Built Drawings: At the end of the work included in this Section submit a complete set of reproducible drawings incorporating all changes, additions and deletions to the Construction Drawings due to revisions, change orders, field conditions, or any other reason.

1.7 QUALITY ASSURANCE

- A. Comply with the referenced ASTM standards for materials.
- B. Verification of accuracy:
 - 1. Engage and pay for a registered Professional Engineer or licensed Land Surveyor to check the alignment, plumbness, elevation, and overall accuracy of the erected framing at appropriate stages during construction and at completion of erection. Prior to erection, a survey shall be made of the as-built locations of all anchor rods and other embedded items associated with the attachment of structural steel. The party providing the survey shall submit written verification that the entire installation is in accordance with the contract documents and meets the allowable erection tolerances as set forth in the AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. Columns shall be verified at each lift. Column shim details and procedures shall be submitted for review.
- C. Tests and Inspections: Provide special inspections and testing as described in the "Statement of Structural Special Inspections and Testing" within the structural drawings and as required by this section.
 - 1. Unless waived in writing by the Architect and the Authority Having Jurisdiction, all materials, work, methods and equipment shall be subject to inspection at the mill, fabricating plant and at the building site. Material or workmanship not complying fully with the Contract Documents will not be accepted. The Contractor shall give the Testing Laboratory reasonable notice when ready for inspection and shall supply samples and test pieces and all facilities for inspection without extra charge.
- D. Testing Agency: Shop and field testing and inspection of steelwork specified in this document or requested by the Owner will be performed by an independent agency engaged by the Owner.
 - 1. The Testing Agency shall be furnished with the following:
 - a. One complete set of fabrication and erection drawings.
 - b. Material bills, cutting lists, order sheets and mill test reports.
 - c. Information regarding time, place of rolling and shipment of materials to shop.

- d. If requested, representative sample pieces for testing.
 - e. Full and ample means and assistance for testing materials.
 - f. Access and facilities, including scaffolding, temporary work platforms, etc., for testing and inspection at all places where materials or components are stored, fabricated or erected in the mill, shop or field.
 - g. Complete set of welding procedures.
 - h. Welder qualifications.
 - i. Reports for all Contractor tests and inspections.
2. In addition to the work specified elsewhere in the Contract Documents, the Testing Agency shall review the following for compliance with project specifications:
- a. Fastener Installation Procedures.
 - b. WPSs and WPQRs.
 - c. Manufacturer's Test Reports and Certifications.
 - d. Welder qualification.
- E. Comply with applicable provisions of the governing building code, reference standards, specifications, and documents, except where more stringent requirements are shown or specified.
- F. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 12 13.
- G. All work shall be performed by qualified operators experienced in their field of work and as otherwise required by these specifications.
- H. Fabricator Qualifications: a fabricator that regularly fabricates structural steel members and components specified in the contract documents, demonstrating satisfactory service on a minimum of five (5) similar installations for a minimum of five (5) years. Provide a project experience list with contact names and addresses for completed projects.
- I. Installer Qualifications: a steel erector that regularly erects and installs structural steel members and components specified in the contract documents, demonstrating satisfactory service on a minimum of five (5) similar installations for a minimum of five (5) years. Provide a project experience list with contact names and addresses for completed projects.
- J. Shop-Painting Applicators: A qualified applicator with a minimum of 12 months prior experience working with the fabricator.

- K. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 for each process, position and joint configuration. Each operator shall have been qualified as prescribed by AWS and shall be approved by the Testing Agency. Qualification performed more than six months prior to the start of the welding by the welder is acceptable, provided written documentation is submitted showing that the welder has continued to use the applicable welding process on an ongoing basis since the test was conducted, with no lapse in service exceeding six months.
1. Welder Certificates shall be submitted to Testing Agency prior to welding.
 2. Welders shall be checked by welding inspector. Those not doing satisfactory work may be removed, and may be required to pass qualification tests again. All qualification testing shall be at the Contractor's expense.
 3. Require welders to retake the qualification test if, as determined by the Architect or Testing Agency, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, he shall not perform any welding on the project.
 4. In addition to AWS D1.1 requirements on welder Qualification, qualify welders making welds with restricted access (such as welding the bottom flanges of girders to column flanges through cope or access holes in the girder webs) by using a mock-up assembly identical to the actual conditions of producing weldments in the field, using the approved WPS.
 5. Welder qualification shall include passing the bend test.
 6. Welders and welding operators performing work on Demand Critical Welds, beam bottom flange to column welds, or welds that must be made by welding through a beam access hole shall pass the supplemental welder qualification testing, as required by AWS D1.8.
 - a. Supplemental Qualification test shall be in accordance with AWS D1.8. The qualification test specimens shall be made with the same electrodes, processes and welding procedures that will be used on this project and also using the highest weld deposition rate allowed by the WPS.
 - b. Documentation showing that a welder has passed a similar qualification test within the last 36 months will be acceptable if in the opinion of the Testing Agency the test meets the criteria.
 - c. Testing Agency will perform and/or witness the tests on the qualification test specimen.
 - d. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- L. Contractor's Quality Control Plan: Quality Control includes the functions performed by the Contractor to ensure that the material and workmanship of structural steel construction meets the project specifications and applicable standards. The Contractor shall submit a Quality Control Plan that addresses all inspection issues, including fabrication/erection testing and inspection per AWS D1.1, AWS D1.8 and AISC 341 Chapter J. The verification testing and inspection carried out by the Testing Agency does not relieve the contractor of the responsibility for conducting their own quality control/inspection program to ensure the requirements of the Contract Documents

have been met. The Contractor's Quality Control Plan will be reviewed by the Testing Agency.

- M. Protected Zone: The Contractor's Quality Control Plan shall include procedures that will be followed to ensure the Protected Zone is clearly identified on the required elements of the Seismic Load Resisting System and all necessary subcontractors are made aware of the requirements of this section.
- N. Quality Control Inspector Qualifications: Along with Quality Control Plan, Contractor shall submit written qualifications for all inspectors to be assigned Quality Control functions for structural steel work, including general inspection, bolting inspection, welding inspection, and non-destructive testing. Qualifications for welding inspectors shall show evidence of ability to monitor all WPS variables, check weld sizes, and visually detect weld defects.
- O. Prefabrication and Preinstallation Conference: Prior to performing fabrication or erection work, there shall be a pre-fabrication and pre-erection meeting to review welding procedures, bolting procedures, and inspection requirements for all welding and bolting operations. The meeting shall include the following individuals: Owner's Representative, Testing Agency, Special Inspector, Steel Fabricator and Erector personnel supervising the shop, field and Quality Control work.
- P. Paint:
 - 1. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommend limits.
 - 2. Coordination of Work: Review other Sections in which prime paints are to be provided to ensure compatibility of coatings system for various substrates. Upon request, furnish information or characteristics of finish materials to be used.
 - 3. Requirements of Regulatory Agencies: Comply with applicable rules and regulations of governing agencies for air quality control.
- Q. Maintain one copy of each document on site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
- C. Requirements for storage and handling of electrodes shall be per AWS D1.1 and AWS D1.8. Additional requirements include:
 - 1. Long term storage of weld consumables shall be indoors, where moisture or dew does not collect, and in undamaged manufacturer's shipping bags, boxes, and containers.
 - 2. Open Flux Cored Arc Welding (FCAW) electrodes shall be completely covered during hours of non-use (i.e., weekends, nights of nonuse, days of nonuse, etc.).

Where rain or dew could be expected to collect (i.e., open floors of erection site, open shop bays, etc.), electrodes shall also be covered.

3. Electrode Storage and Exposure Limits for Demand Critical Welds: The exposure time limit for electrodes shall be in conformance with AWS D1.8 Section 6.4.

1.9 COORDINATION

- A. Surveys: Contractor shall conduct field surveys and field verification as required to incorporate existing conditions from previous works, such as foundations and existing buildings, to the work before shop drawings are produced.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions for installation.
- C. Notify the Owner's Representative in sufficient time prior to shop or field fabrication or erection to permit testing and inspection without delaying work.
- D. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All hot rolled steel shapes, plates, and bars shall be new steel conforming to ASTM A6, unless otherwise noted in the Drawings. Structural steel shall be as follows:
 1. Wide Flange and WT Shapes: ASTM A992.
 2. M- and S- Shapes: ASTM A572 Gr.50.
 3. C- and MC- Shapes: ASTM A992.
 4. L- Shapes: ASTM A572 Grade 50.
 5. Round HSS: ASTM A500 Grade C (Fy = 50 ksi).
 6. Rectangular HSS: ASTM A500 Grade C (Fy = 50 ksi).
 7. Pipe: ASTM A53, Grade B (Fy = 35 ksi).
 8. Base Plates up to 4" thick: ASTM A572 Grade 50.
 9. All other Plate Material: ASTM A572 Grade 50.
 10. Built-Up Columns: ASTM A572 Grade 50.
 11. Plate Girders: ASTM A572, Grade 50.
 12. Connection Material:
 - a. Column Continuity Plates and Doubler Plates: ASTM A572 Grade 50.
 - b. Brace Frame Gusset Plates: ASTM A572 Grade 50.
- B. Heavy sections as defined in this specification: ASTM A36 and/or ASTM A572 Grade 50 with supplementary requirements S5 Charpy V-Notch Impact Test and ASTM A6 with supplementary requirements S91 Fine Austenitic Grain Size. For location of

Charpy V-Notch test, see ASTM A6 Supplementary Requirement S30. Charpy V-Notch test shall be per ASTM A673, frequency P and shall meet a minimum average value of 20 ft-lbs absorbed energy at 70 degrees Fahrenheit.

- C. Steel using complete joint penetration groove welds that fuse through the thickness of the flange or web that is part of the SFRS shall have a minimum Charpy V-notch impact testing value of 20 ft-lbs at 70 degrees Fahrenheit.
- D. Heavy Sections in the Seismic Force-Resisting System shall be supplied with Charpy V-notch (CVN) testing in accordance with AISC 341 requirements.

E. Welding Materials

- 1. Welding Material: Filler metal requirements shall conform to AWS D1.1, and AISC "Specification for Structural Steel Buildings". Filler metal used in welds designated as part of the SFRS or as Demand-Critical shall comply with AWS D1.8. Minimum classified tensile strength of 70 ksi (E70). Use low hydrogen electrodes as defined by AWS D1.1, unless noted otherwise. For all CJP welds used on Heavy Structural Sections that are not part of the Seismic Load Resisting System the filler metal shall have a Charpy V-Notch (CVN) toughness of at least 20 ft-lb at 70 degrees Fahrenheit.
- 2. Welding Materials for Seismic Force Resisting System:
 - a. All filler metal used in the Seismic Load Resisting System shall have a Charpy V-Notch (CVN) toughness not less than of 20 ft-lb at 0 degrees Fahrenheit, using AWS A5 classification test methods.
 - b. Filler metal for welds defined as Demand Critical Welds (DCW) shall have a Charpy V-Notch (CVN) toughness of 20 ft-lb at minus 20 degrees Fahrenheit as determined by the appropriate AWS classification test method and 40 ft-lb at 20 degrees above the lowest anticipated service temperature of the structure as determined by AISC 341 and AWS D1.8.
 - c. Refer to AISC 341 and AWS D1.8 for additional filler metal requirements.

F. Bolts, Connectors, and Anchors

- 1. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts unless noted otherwise; ASTM A563, Grade C heavy-hex carbon-steel nuts or equal per ASTM A325-10 Section 3.2; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish. ASTM F1852 Twist-Off Type Torque Control Bolts are a suitable alternative to ASTM A325 bolts.
- 2. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy-hex steel structural bolts, where noted on drawings; ASTM A563, Grade DH, heavy-hex carbon-steel nuts or equal per ASTM A490-10 Section 3.2; and ASTM F436, Type 1, hardened carbon-steel washers with plain finish. ASTM F2280 Twist-Off Type Torque Control Bolts are a suitable alternative to ASTM A490 bolts.
- 3. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

- a. Finish: Hot-dip zinc coating.
 - b. Zinc-Coated ASTM F1852 Twist-Off Type Torque Control Bolts are a suitable alternative to ASTM A325 bolts.
4. Unfinished Bolts and Nuts (Machine Bolts) and Threaded Rods: ASTM A307, Grade A, low carbon steel bolts and nuts; ASTM F436, Type 1, hardened carbon-steel washers.
5. Shear Studs: ASTM A108, Grades 1015 or 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B and conform to requirements of AWS D1.1 Section 7.
- a. Tensile strength, 60,000 psi.
 - b. Elongation in 2 inches, 20 percent
 - c. Reduction of area, 50 percent.
6. Unheaded Anchor Rods: ASTM F1554 Grade 36, Grade 55 (weldable per S1 Supplementary Requirements), or Grade 105, where noted on drawings.
- a. Configuration: Straight
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - d. Washers: ASTM F436, Type 1, hardened carbon steel.
 - e. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.
7. Headed Anchor Rods: ASTM F1554 Grade 36, ASTM F1554 Grade 55, weldable where notes on drawings, or ASTM F1554 Grade 105.
- a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - c. Washers: ASTM F436, Type 1, hardened carbon steel.
 - d. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.
8. Threaded Rods: ASTM A36 or A572, Grade 50.
- a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - c. Washers: ASTM F436, Type 1, hardened carbon steel.
 - d. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.

9. Williams 150 KSI All-Thread-Bars.
 - a. Nuts: ASTM A29 or A576 hex.
 - b. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - c. Washers: ASTM F436, Type 1, hardened carbon steel.
 - d. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.
 - e. Williams 150 ksi All-Thread-Bar is not to be subjected to the heat of a torch, welding or used as a ground.
10. Tie Rods: ASTM A36 or A572, Grade 50.
 - a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Washers: ASTM F436, Type 1, hardened carbon steel.
 - c. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C
11. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035. Dimensions and minimum capacities to conform to the values listed in AISC "Steel Construction Manual".
12. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1030.
13. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1018. Minimum proof load of sleeve nuts shall be such that when loaded axially the sleeve nut shall be stronger than the ultimate capacity of the connected parts.
14. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following manufacturers:
 - 1) Amscot Structural Products Corp.
 - 2) Fluorocarbon Company Limited.
 - 3) R.J. Watson Bridge & Structural Engineered Systems.
 - 4) Seismic Energy Products, L.P.
 - b. Mating Surfaces: to be specified.
 - c. Coefficient of Friction: to be specified.
 - d. Design Load: to be specified.
 - e. Total Movement Capability: to be specified.

G. Primer

1. Comply with Division 09.
2. Primers and paints shall meet all federal and state environmental and air quality requirements.
3. Primer Paint shall comply with all applicable SSPC requirements and shall be compatible with finish paints and spray-on fireproofing specified elsewhere.
4. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 per ASTM A780.
5. Primer:
 - a. Typical Interior Primer: SSPC-Paint 25, Type II or SSPC-Paint 23. Primer shall comply with the requirements called out in the "Green Seal Standard for Anti-Corrosive Paints" (GC-03).
 - b. Typical Exterior Primer: SSPC-Paint 20, Type II, Organic.

H. Non-Shrink Cementitious Grout

1. Grout shall have a minimum 3,000 psi compressive strength at 48 hours and 7,000 psi compressive strength at 28 days.
2. Metallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
4. See Section 03 30 00 for acceptable products and additional requirements.

2.2 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 and AISC 360.

1. Camber structural-steel members where indicated. Fabricate beams and girders with natural camber upward, unless noted otherwise on the drawings.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A6 and maintain markings until structural steel has been shop erected.
4. Mark and match-mark materials for field assembly. Members shall be fabricated for delivery in a sequence that will expedite erection and minimize field handling of structural steel.
5. Splice members only where indicated on Structural Drawings or where accepted by the Structural Engineer.
6. All hollow members exposed to weather shall be sealed with continuous welds, incorporating structural welds where shown or required, or provide weep holes where water may accumulate.
7. Grind burrs, sharp arises and ragged edges that would prevent solid seating of the connected parts.
8. AISC Group 4 and 5 shapes and built up members shall meet the requirements for joints in AISC Sections J1.5, J1.6, J2.7 and M2.2.

9. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Holes and attachments to structural steel in areas designated as the Protected Zone are not allowed except as explicitly shown or noted on structural drawings.
- C. Tolerances: Except as noted as follows, maintain fabrication tolerances of structural steel within the tolerances specified on the drawings and AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible. An unguided torch may be used provided the cut is within 1/8 inch of the required line.
 1. Plane thermally cut edges to comply with requirements in AWS D1.1.
- E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
 1. Use standard holes unless otherwise indicated on the Drawings. Holes shall be drilled or punched at right angles to the surface of the metal. Making or enlarging holes by burning is prohibited.
 2. Flame cut holes for fasteners are not acceptable.
 3. Holes in column baseplates shall be within the limits of Table 14.2 of AISC "Steel Construction Manual".
- F. Bending Steel Plate:
 1. Bend plates perpendicular to the rolling direction.
 2. Grind flame cut plate edges transverse to the bend line.
 3. Grind out nicks in plate edges transverse to the bend line.
 4. Round sharp corners on plate edges transverse to the bend line.
 5. Bent plate deck edge closure may be excluded from Items 1-4 above.
- G. Heat Straightening: Will be permissible by the use of properly controlled heat, skilled personnel, proper equipment and in accordance with documents prepared by the fabricator and accepted. Reject materials that contain kinks or sharp angles. Material straightened prior to fabrication shall be rejected where it shows signs of distress or defects.
- H. Planing and Milling:
 1. Bearing surfaces of columns and base plates shall be finished and constructed in accordance with AISC 360 Section M2.6, M2.8 and M4.4.
 2. Bearing surfaces of column end cuts shall meet a surface roughness of 500 micro inches or better.
- I. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning" or SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 3, "Power Tool Cleaning."
- J. End-Welded Studs:

1. Automatic end-welded studs: Automatically end-weld in accordance with the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plates. There shall be no porosity or evidence of lack of fusion between the welded end of the stud and the plate. The stud shall decrease in length during welding approximately 1/8 inch for 5/8 inch, and 3/16 inch for 3/4 inch diameter. Stud sizes indicated on drawings represent the finish stud height.
 2. Fillet-end welded studs: Studs may be welded using prequalified FCAW, GMAW, or SMAW processes provided the requirements of the AWS D1.1 Chapter 7 Section 7.5.5 are met as well as any other pertinent requirements of D1.1.
- K. Bolt Holes and Holes for Other Work: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Provide holes, slots and openings together with necessary reinforcing as shown on the Drawings required for securing work of other trades to the work specified here. Where openings are shown on the Drawings no change shall be permitted without prior approval. Openings shall be done in the shop.
 2. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
 4. Unless noted otherwise, make holes 1/16 inches larger than the nominal bolt diameter.
- L. The Contractor shall cooperate fully with requests from inspection and testing personnel for access to the connections and joints to be inspected and tested. This includes beam and column turning in shop, weld backing removal when nondestructive examination indicates rejectable conditions, and access to platforms or scaffolding as required to perform the work safely.
- M. Any technique not covered by this section shall be submitted to the SEOR for approval.

2.3 SOURCE QUALITY CONTROL

- A. Testing Agency: Testing Agency to perform shop tests and inspections as defined by AWS, AISC and these specifications. Testing Agency shall summarize their finding in inspection and testing reports. Reports shall identify any findings that are not in compliance with requirements of the project specifications.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. See Part 1 of this specification for additional testing and inspection requirements. As a minimum the inspector will make all tests and inspections as required by the Special Inspection provisions of the governing building code. Testing Agency will make all the tests and inspections indicated in the Contract Documents.
- C. Contractor shall correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

1. Owner's Representative reserves right, at any time before final acceptance, to reject material not complying with requirements.
 2. Any tests that may be necessary to reconfirm any noncompliance of original work, and as may be necessary to show compliance of corrected work, shall be at Contractor's expense.
- D. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the Inspector can refer back to the person making the connection.
- E. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
1. High Strength Bolted Connections: Furnish certified test reports for each lot of bolts in accordance with Section 9 of ASTM A325 and A490. Install bolts under the supervision of a qualified inspector in accordance with Section 9, Research Council "Specifications for Structural Joints using ASTM A325 or A490 Bolts". High strength bolts specified as Snug-Tight (ST) need not be inspected for bolt tension. For high strength bolts specified as Slip-Critical (SC), verify that 10% or a minimum of 2 bolts per connection are tensioned in accordance with the RCSC Specification.
 2. If high strength bolting inspection is indicated on the structural drawings or required by the applicable referenced standards, the testing laboratory shall provide inspection in accordance with AISC 360 Section N.
 3. High Strength Bolted Connections in the Seismic Force Resisting System will, in addition, comply with the required inspection in AISC 341 Section J.
 4. Tension Calibrator: A tension measuring device shall be required at all job sites where bolts in slip-critical joints are being installed and tightened. The tension measuring device shall be used to confirm: (1) the suitability to satisfy the requirements of AISC for the complete fastener assembly, including lubrication if required to be used in the work, (2) calibration of wrenches, if applicable, and (3) the understanding and proper use by the bolting crew of the method to be used. The frequency of confirmation testing, the number of tests to be performed and the test procedure shall be as specified in 1.d. below, as applicable. The accuracy of the tension measuring device shall be confirmed through calibration by an approved testing agency at least annually.
 5. Direct Tension Indicators: Observe all Direct Tension Indicators to see if proper tightness was achieved.
 6. Joint Assembly and Tightening of Shear/Bearing Connections: Bolts in connections not within the slip-critical category shall be installed in properly aligned holes, but need only be tightened to the snug tight condition. The snug tight condition is defined as the tightness that exists when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. If a slotted hole occurs in an outer ply, a flat hardened washer or common plate washer shall be installed over the slot.
 7. Joint Assembly and Tightening of Connections Requiring Full Pre-tensioning. Slip-critical connections shall be installed in properly aligned holes and tightened by one of the following methods.

- a. Turn-of-nut Tightening: When turn-of-nut tightening is used, hardened washers are not required except as specified in the AISC. A representative sample of not less than three bolts and nuts of each diameter, length and grade to be used in the work shall be checked at the start of work in a device capable of indicating bolt tension. The test shall demonstrate that the method of estimating the snug-tight condition and controlling turns from snug tight to be used by the bolting crews develops a tension not less than five percent greater than the tension required for slip-critical connections.
 - b. Installation of Alternate Design Bolts: A representative sample of not less than three bolts of each diameter, length and grade shall be checked at the job site in a device capable of indicating bolt tension. The test assembly shall include flat hardened washers, if required in the actual connection, arranged as in the actual connections to be tensioned. The calibration test shall demonstrate that each bolt develops a tension not less than five percent greater than the tension required by AISC. Manufacturer's installation procedure shall be followed for installation of bolts in the calibration device and in all connections. When alternate design features of the fasteners involve an irreversible mechanism such as yield or twist-off of an element, bolts shall be installed in all holes of the connection and initially brought to a snug tight condition. All fasteners shall then be tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners prior to final twist-off or yielding of the control or indicator element of the individual fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic tightening.
- 8. Mark bolts that have been completely tightened with an identifying symbol.
 - 9. Standard Bolted Connections: Testing Agency shall inspect the installation of A307 bolts to verify that 10% of all bolts or a minimum of 2 bolts per connection are installed properly and tightened to a Snug-Tight (ST) condition.

F. Welded Connections:

- 1. Testing Agency shall be present during welding operations as necessary to perform required testing and inspections.
- 2. Welding equipment: Welding equipment to be used in each case shall be acceptable to welding inspector. Use equipment with suitable devices to regulate speed, and manually adjust operating amperage and voltage. The amperage capacity shall be sufficient to overcome line drop, and to give adequate welding heat.
- 3. Welded Joint Details as Part of the SFRS:
 - a. Weld in accordance with AWS D1.8.
 - b. Weld Backing: The use of weld backing shall be in accordance with AWS D1.1. Weld backing shall be removed where required by the Contract Documents or for the WPS by AWS D1.1.

- 1) Connections of the SFRS in which backing is not removed: backing shall be attached to the member or plate that does not have its surface prepared for the groove weld. Attachment shall be by either a 5/16" fillet or 3/16" groove weld along the complete bar length on the side of the bar opposite the groove weld.
 - 2) Beam-Column Connection Joints Requiring Removal of Weld Backing: Conform with AWS D1.8. Perform MT on the fillet weld and the immediately adjacent area.
4. Visual Inspection of Welding: Testing Agency shall visually inspect shop and field welding of structural steel in accordance with the governing building code and AWS D1.1. Visual inspection of welds shall include but not be limited to the following:
 - a. Verify: Welding Procedure Specification (WPS) sheet has been provided and has been reviewed with each welder making the weld, welder qualification and identification, fit-up meets tolerances of WPS and mark joint prior to welding, welding consumables are per the Contract Documents and the WPS, amperage and voltage at the arc with hand-held meters, meters on welding equipment are functioning and accurate.
 - b. Observe preheat and interpass temperatures, weld pass sequence and size of weld bead.
 - c. Multi-pass shop and field welds shall be inspected as required per the governing building code, AWS D1.1, AWS D1.8, AISC 360 Table N5.4 and AISC 341 Table J6.
 - d. Visually inspect welds of heavy structural sections, or plates of 1-1/2 inch minimum thickness, as follows:
 - 1) Columns – visually inspect first two (2) production columns 48 or more hours after completion of welding. If columns successfully pass inspection, no additional 48 hour delayed visual inspections are required.
 - 2) Plate Girders – visually inspect all plate girders 48 or more hours after completion of welding for presence of cracks.
 - e. Visually inspect areas where backing bars and welds tabs are removed for conformance with the surface roughness criteria of the specifications.
 - f. Verify that the effective throat thickness of flare groove welds is consistently obtained when flush to bar or section. This verification shall be based on test sections where necessary.
5. Nondestructive Testing Requirements: Testing Agency shall perform non-destructive testing of shop and field welding in accordance with the project specifications, governing building code, and AWS D1.1. Extent of non-destructive testing shall be as follows:

- a. Complete Joint Penetration (CJP) welds: UT 100% CJP welds greater than 5/16-inch. MT 25% all DCW CJP welds. MT 100% of all DCW CJP weld ends.
 - b. Partial Joint Penetration (PJP) welds: UT 100% of PJP welds greater than 5/16-inch. UT 100% PJP in column splices.
 - c. Column Web Material at Continuity Plate: MT the WF column webs 3-inches above and below the weld terminations at the first 50 continuity plates and doubler plates installed. Test shall be conducted when weld has cooled to ambient temperature. If no web cracks are found, then no more testing required. This test shall also be conducted for all locations where the Contractor has welded into the "no weld" zone shown on the Drawings for continuity plates.
 - d. Access holes at splices in Heavy Structural Sections – MT or PT 100%.
6. Special non-destructive testing for welds in the Seismic Force Resisting System shall have additional testing per AISC Seismic Provisions, AWS D1.8 and the governing building code, and as follows:
- a. Backing Bars Removed - MT 20% of the locations where the backing bars and weld tabs are removed after the roughness criterion is attained.
 - b. Reinforcing Fillet Weld placed where backup bars are removed - MT 100% of the welds.
 - c. Access holes and copes in SMRF beams – MT or PT 100%.
 - d. Heavy Structural Section flanges and/or plate thicker than 1-1/2 inches where subject to through-thickness weld shrinkage strains (including column flanges and base plates) – UT flange or plate material for lamellar discontinuities 3" to each side of CJP weld prior to CJP weld (this includes base plates). If rejectable defects are found then beam shall not be welded to the flange or plate at this location. This test should be conducted in the shop. In addition, UT material after weld for discontinuities behind and adjacent to such welds. The test procedure and acceptance criteria shall be per ASTM A898 Level I or ASTM A435.
 - e. Fillet Welds: Fillet welds of gusset plates to beams, columns and base plates - MT 10% of the following fillet welds and reduce to 5% if no significant cracks are found in the first 50 tested: a) gusset plate fillet welds to beam and columns; b) base plate fillet welds.
7. All full penetration groove welds will be subject to ultrasonic testing, as per AWS D1.1, Clause 6 "Inspection, Part "F", Ultrasonic Testing (UT) of Groove Welds. All defective welds shall be repaired and retested with ultrasonic equipment at the Contractor's expense.
8. Box columns and built-up members shall have ultrasonic testing before and after welding.

9. Column Flanges: An area extending 6 inches above and below point where girder flanges are attached will be inspected. Column flange edges will be inspected visually and entire area ultrasonically for lamination, plate discontinuities, and non-metallic inclusions.
 10. When ultrasonic indications arising from the weld root can be interpreted as either a weld defect or the backing strip itself, the Engineer will be notified. The Engineer may require the removal of backing strip. The backing strip will be removed at the expense of the Contractor, and if no root defect is visible the weld will be retested. If no defect is indicated on this retest, and no significant amount of base and weld metal have been removed, no further repair of welding is necessary. If a defect is indicated, it will be repaired and retested at Contractor's expense.
 11. The ultrasonic instrumentation will be calibrated by the technician to evaluate the quality of the welds in accordance with AWS D1.1.
 12. Other methods of inspection, for example, X-Ray, gamma ray, magnetic particle, or dye penetrant, may be used on welds if felt necessary by the inspection laboratory, and with the approval of the Engineer.
 13. Base metal thicker than 1-1/2 inches, when subjected to through thickness weld shrinkage strains, shall be ultrasonically inspected for discontinuities directly behind such weld before and after joint completion.
 14. At the discretion of the owner's testing agency, except for Demand Critical Welds as per AISC 341 Section J6.2g, the ultrasonic testing frequency may be reduced but may not be less than the following:
 - a. Initially, all welds requiring ultrasonic testing will be tested at the rate of 100 percent in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5 percent of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25 percent. If the reject rate increases to 5 percent or more, 100 percent testing will be re-established until the rate is reduced to less than 5 percent. The percentage of rejects will be calculated for each welder independently.
 - b. A sampling of a least 40 completed welds will be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3 ft in length where the effective throat is 1" or less, each 12 inch increment or fraction thereof shall be considered as one weld. For evaluating the reject rate of continuous welds over 3 ft in length where the effective throat is greater than 1", each 6 inch of length or fraction thereof shall be considered one weld.
- G. In addition to visual inspection, shop-welded shear studs will be tested and inspected according to requirements in AWS D1.1 and the governing building code for stud welding and as follows:
1. The type and capacity of the welding equipment shall be in accordance with the manufacturer's recommendations and shall be checked and approved.
 2. At the beginning of each day's work, a minimum of 2 test stud welds shall be made, with the equipment to be used, to metal which is the same as the actual

work piece. The test studs shall be subjected to a 90-degree bend test by striking them with a heavy hammer. After the above test, the weld section shall not exhibit any tearing or cracking.

3. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
4. Tests will be conducted on additional shear studs if weld fracture occurs on shear studs already tested, according to requirements in AWS D1.1.

H. Inspection Records

1. The inspector will maintain a daily record of the work that has been inspected and its disposition. One copy of each report will be submitted to the Owner on a weekly basis. Test reports will be made on the form suggested in the AWS D1.1 "Structural Welding Code".
2. Make systematic record of all shop welds, including:
 - a. Date of inspection.
 - b. Location and type of weld.
 - c. Identification marks of welders.
 - d. List of defective welds.
 - e. Manner of correction of defects.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Discrepancies: In the event of discrepancy, immediately notify the Owner's Representative in writing. Do not proceed with construction in the region of the discrepancy until all such discrepancies have been resolved.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. The Contract Drawings indicate the completed structure. The Contractor is fully responsible for all temporary measures necessary for erection, except where specific sequences and requirements are specified on the Drawings.
 2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.
- B. Furnish templates for exact locations of items to be embedded in concrete and any setting instructions required for installation.

3.3 CONNECTIONS

A. General Bolting:

1. Product containers must be marked with lot numbers and traceability information so that correspondence with mill reports can be established. Manufacturer's symbol and grade markings shall appear on all bolts, nuts, through-hardened washers and direct tension indicators.
2. Bolts shall be of a length that will extend to a point at least flush with the surface of the nuts, though not more than a length equal to the height of the nut, beyond the nuts unless otherwise noted.
3. Bolts shall be installed with threads excluded from the shear plane.
4. Washers shall be used on all bolts. Use beveled washers where bolts bear on sloping surface.

B. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified. Contact surfaces of bolted parts shall as a minimum comply with the Class A requirements.

1. Joint Type shall be as noted on drawings.
2. Direct tension indicator (load indicating washers or "Tension-Set" bolts) method shall be used at slip-critical connections. "Turn-of-Nut" methods are not an acceptable alternative.
3. When connection has bolts and welds, fully tighten bolts prior to welding with the exception that in moment connections the flange welds shall be completed prior to final tightening of high strength bolts.
4. When already tensioned bolts have had their tension relaxed, replace the bolt and tension indicator and re-tighten.

C. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work. Quality of materials and design and fabrication of all welded connections shall conform to AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Building," "AWS Code for Welding in Building Construction," and requirements of this section.

1. Location and type of all welds shall be as shown. Make no other welded splices, except those shown on drawings, without prior approval of the Structural Engineer.

2. Automatic Welding: Use electrode wire and flux for automatic and semi-automatic welding acceptable to Structural Engineer. All methods, sequences, qualification and procedures, including preheating, and post heating if necessary, shall be detailed in writing and submitted to the Structural Engineer for review.
3. Preparation of surface: Surfaces to be welded shall be free of loose scale, slag, rust, grease, paint, and any other foreign material.
4. Shop welds shall be inspected in the shop before the work is painted or shipped.
5. Control cooling process after weld is completed by either step down post heat or thermal blankets as determined by procedures and prequalification.
6. Weld sizes where shown shall be assumed to be effective weld sizes.
7. All groove or butt welds shall be full penetration unless noted otherwise on the Drawings.
8. Where structural steel members are to remain exposed in the finished work, welds exposed to view shall be uniformly made and ground smooth.
9. Remove runoff tabs and grind surfaces smooth where the tabs would interfere with architectural finishes.
10. Weld tabs shall be in accordance with AWS D1.1. In addition, weld tabs shall extend beyond the edge of the joint a distance not less than 1-inch except at access holes in beam/girder webs and at continuity plate clips. Weld tabs shall be oriented parallel to the joint preparation and to the weld direction. Weld dams are not allowed.
11. Remove weld tabs and backup plates and grind surfaces smooth as required for inspection or testing. Where tabs or backup bars interfere with architectural treatment or are exposed to view in the final structure, remove and grind smooth.
12. Splices of members in tension, all members of moment frames and all members of braced frames that are made from heavy steel sections shall be made in conformance with Section J1.5 of AISC 360.
13. Weld variables shall be consistent with the recommendations of the electrode manufacturer.
14. Do not weld into column flange-to-web intersection as defined the AISC “k” and “k1” distances except for the doubler plate to column welds. Continuity plate welds shall stay clear of this area as noted on the drawings.
15. Sequence the work as necessary to accommodate testing.
16. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
17. Welding Procedures:
 - a. Weld only in accordance with the Welding Procedure Specifications. WPS shall be readily available to all welders, inspectors, and supervisors during the production process.
 - b. Consider toughness and notch sensitivity of steel in formation of the welding procedures to prevent brittle and premature fracture during fabrication and erection. Toughness requirements are to match those of the parent metal.
 - c. Weld in a manner to minimize accumulation and concentration of through-thickness strains due to weld shrinkage. Sequence welds in a manner to reduce residual stresses (caused by welding) to a minimum value.

Welding procedures shall incorporate measures necessary to eliminate cracking.

- d. Do not mix different electrodes in the same weld joint unless the interactions have been shown not to cause problems.
- e. Stringer passes only, no weaving or wash passes. Manipulation of the electrode for vertical welds (oscillation) shall be kept to a maximum movement of 4 to 5 electrode diameters.
- f. Welding shall not begin until joint elements are bolted or tacked in intimate contact and adjusted to dimensions shown in the Drawings, with proper allowance for any weld shrinkage.
- g. All tack welds shall be of the same quality as final welds. Tack welds within Demand Critical welds at Seismic Force Resisting System members shall be per AWS D1.8; all other tack welds shall be per AWS D1.1.

18. Additional Welding Requirements:

- a. Weld Access Holes shall be in accordance with AISC Specification J1.6 and AWS D1.1 except as otherwise noted in the Construction Documents. The access hole shall be ground smooth to a surface roughness not to exceed 500 micro-inches, and shall be free of notches and gouges. For this purpose, a notch or gouge is any depression deeper than the overall surface roughness.
- b. Pay increased attention to uniform and adequate preheat.
- c. Maximum interpass temperature not to exceed 550 degrees F when notch toughness properties are specified.
- d. Complete individual weld layers prior to applying portions of subsequent layers. Ends of interrupted passes to be staggered. Minimize starts and stops within body of the weld.
- e. Where required by specifications and/or contract drawings, remove backing bars and apply reinforcing fillet weld per note J of figure 3.4 of AWS D1.1 and AWS D1.8 section 6.7 and 6.8. Remove backing bar with air carbon arc cutting, grinding, chipping or thermal cutting. The process shall be controlled to minimize gouging and removal of base metal except for material immediately adjacent to the weld. After removal of backing the root shall be backwelded with a reinforcing fillet weld with a minimum leg of 5/16-inch.
- f. At continuity plate to column welds, the backing bars do not need to be removed.
- g. At Demand Critical Welds: Cut off weld tabs 1/8-inch (1/4-inch at continuity plates) from the edge and grind to a surface roughness of 500 micro-inches or better.

- h. Where bottom cover plates are acting as back-up plates, welds in the vicinity of the web cope area shall be carefully checked by ultrasonic inspection. Any indication of weld discontinuities shall be cause to remove suspect portions of welds by cut-outs. The cut-out areas shall be ground smooth to sound bright metal for visual inspection. If visual inspection is inconclusive or questionable, verify by magnetic particle testing. If weld defects, slag inclusions, etc. are present, remove them by air arcing and clean up by grinding. Repair welds and add a reinforcing fillet weld at least 1/4 of the bottom flange thickness but need not be greater than 5/16 inch. If there are no defects, clean up by grinding and reinforce with fillet weld. Ultrasonic testing (UT) inspection shall be conducted from both sides of the flange to ensure sound welds.
- i. Flame cut surfaces at weld access holes within heavy sections shall be ground per AISC 360 Section M2.2.

D. Refer to the Structural Drawings for additional requirements.

3.4 SHOP PRIMING

- A. Shop prime all steel surfaces which, in the final constructed condition, are exposed to weather or not completely concealed by building finishes unless noted otherwise and excepting the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded and areas within 4 inches on each side of field welds.
 - 3. Top surfaces of beams to receive welded metal deck.
 - 4. Contact surfaces to be slip-critical high-strength bolted. Areas exposed to the weather shall receive a Class A primer coat compatible with slip-critical type connections.
 - 5. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 6. Galvanized surfaces.
 - 7. Machined surfaces.
 - 8. Welded shear studs.
 - 9. Where enclosed within the building envelope and is protected from exterior exposure.
- B. Steel members not otherwise painted shall be painted when subjected to condensation from piping, are in shower or steam rooms, are exposed to chemical fumes or are exposed to other conditions of potentially aggressive corrosion
- C. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the applicable SSPC specification requirements for each primer. As a minimum, all surfaces shall be prepared according to the following specifications and standards:
 - 1. SSPC-SP1 "Solvent Cleaning"
 - 2. SSPC-SP 2, "Hand Tool Cleaning"
 - 3. SSPC-SP3, "Power Tool Cleaning"

4. Where jobsite exposure is expected to exceed 6 months, SSPC-SP6 Commercial Blast Cleaning is required.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness as recommended by manufacturer. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Material: Type A Tnemec Company, Inc., Series V10; Sherwin Williams Steel Spec Universal; Metal Case 94-231 Series or approved equal.
 2. Number of Coats: One.
 3. Volume Solids: 56.0 +/- 2.0% minimum.
 4. Generic Description: Modified Alkyd.
 5. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 6. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- E. Unless noted otherwise in subsection G, use the following Type B shop painting systems on all exterior steelwork and interior steelwork subjected to wet conditions or fumes (see subsection G for additional requirements)
1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning
 2. Application: Follow coating manufacturer's printed directions.
 3. Material: Type B Tnemec 90-97 Tneme-Zinc primer or approved equal
 4. Number of Coats: One
 5. Dry Film Thickness: 2.5 to 3.5 mils
 6. Volume Solids: 63% +/- 2%
 7. Generic Description: Zinc-Rich Urethane
- F. Unless noted otherwise in subsection G, use the following finish painting systems on all exterior steelwork and interior steel work subjected to wet conditions or fumes (see subsection G for additional requirements):
1. Application: Follow coating manufacturer's printed directions. Apply over Type B primer system above.
 2. Material: Tnemec Series 750 UVX paint or approved equal
 3. Number of Coats: One
 4. Dry Film Thickness: 2.5 to 5 mils
 5. Volume Solids: 72% +/- 2%
 6. Generic Description: Polyfunctional Hybrid Polyurethane
- G. All exterior steelwork and all interior steelwork subjected to wet conditions or fumes, including all welds, bolts, washers and other connection components, shall be primed and painted or hot-dip galvanized, as specified by the Architectural finish specifications. In the absence of Architectural finish specifications, all exterior steelwork and all interior steelwork subjected to wet conditions and fumes, including all welds, bolts, washers and other connection components, shall be hot-dip galvanized, conforming to the requirements set forth in ASTM A123 and ASTM A153.
- H. All steel exposed to weather in the final structure shall be galvanized or painted.

- I. Use special care if steel is fabricated, cleaned, and painted in damp weather to remove moisture from mill scale cracks.
- J. Clean contact surfaces of high strength bolts of all burrs and material which might prevent solid seating of the parts. Steel to receive bolts shall be primer painted except beneath the contact area of slip-critical bolts.

3.5 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123 and to bolts, nuts, and washers according to ASTM A153. Galvanize all items noted on Drawings to be galvanized and fasteners that connect galvanized components, except that ASTM A490 bolts shall not be hot-dip galvanized. Where ASTM A490 bolts connect galvanized components, use A490 Type 3 bolts.
 - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with engine freeze/core plugs installed per manufacturer's recommendations.
 - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
 - 3. Roughen faying surfaces of slip-critical high-strength bolted connections to achieve Class C surface accordance with the RCSC Specifications.

3.6 ERECTION

- A. Structural steel erection: Comply with AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Building", latest edition.
- B. Erection Sequence: Erect steel in accordance with special erection sequences where special erection sequences are indicated on the contract documents.
- C. Mark each member with erection identification corresponding to mark shown on erection drawings. Carefully plan erection of structural steel so that no cutting and removal of material will be necessary. Do not torch burn in the field, unless specifically permitted by Engineer.
- D. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360. Check plumbness after erection of each tier.
- E. Dimensions shown on drawings are based on an assumed design temperature of 70 degree Fahrenheit. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.
- F. Care shall be taken to protect work already installed from damages resulting from structural steel erection.
- G. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates. Remove any templates used for the setting of anchor bolts.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate at locations that are specified per the structural design details.
 3. Snug-tighten or Pretension anchor rods after supported members have been positioned and plumbed. If used, do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Grout solid under plates with a flowable non-shrink grout per Section 03 30 00 prior to placement of concrete fill over metal deck at any floor level. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- H. Maintain erection tolerances of structural steel within AISC 303.
- I. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
 3. Shimming or other adjustments not indicated on drawings shall be approved by the Engineer prior to installation. Column shimming shall be $\frac{1}{4}$ inch.
- J. All welds shall be full and clean, and conform to AISC and AWS specifications.
- K. Splice members only where indicated.
- L. Do not use thermal cutting during erection unless approved by SEOR. Finish thermally cut sections within smoothness limits in AWS D1.1.
- M. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts. Where a hole is required to be enlarged by more than 3/32-inch ream to and use next larger bolt size.
- N. Shear Studs: Prepare steel surfaces as recommended by manufacturer of shear studs. Use automatic end welding of headed-stud shear studs according to AWS D1.1 and manufacturer's written instructions.
- O. Temporary Shoring and Bracing:
1. The Contract Drawings indicate the completed structure. The Contractor is fully responsible for all temporary measures necessary for erection, except where specific sequences and requirements are specified on the Drawings. See the Drawings for erection sequence notes and minimum requirements.
 2. Contractor is responsible for identifying need for temporary construction and for the design, installation and use of all temporary bracing and supports necessary to stabilize the framing until the structure is complete as indicated on the Contract Documents. Completed structure includes the complete structural steel

framing system, metal deck with complete connections and interconnections, concrete fill where occurs, other non-steel stabilizing structural systems interconnected to the structural steel frame where applicable, e.g. shear walls, grade beams, tie beams, collector beams, etc.

3. Provide temporary works as necessary to erect the structure and achieve proper alignment as erection proceeds. In addition, provide temporary bracing and shoring to brace the incomplete structure against loads such as wind and seismic forces comparable in intensity to the design loads for the completed structure.
4. Make all necessary provisions for temporary bracing and for completion of erection where structural members are temporarily left out for erection at a later time.
5. Temporary bracing shall not impose lateral loads on column anchor bolts unless approved by the SEOR. Contractor shall provide adequate means of column restraint to resolve bracing lateral loads.

P. Temporary Flooring:

1. Provide planking and scaffolding necessary in connection with erection of structural steel, support of erection machinery, and construction materials. Temporary floors and use of steel shall be as required by applicable regulatory requirements.
2. If steel decking is used as a working platform, it shall be temporarily tack-welded to supports to extent necessary for such use in accordance with applicable regulatory requirements. The concentrated loading from welding machines and other heavy machinery required for steel erection shall be distributed by planking or other approved means. Metal decking that becomes damaged as the result of being used as a working platform shall be replaced at no additional cost to the Owner.

Q. Hoisting and Bracing:

1. Provide all hoisting and erecting equipment and power.
2. Provide and maintain any and all safety railings, etc., required for the erection of steel framing and metal decking or as directed by the General Contractor.
3. Brace the erected frame in a manner which will assure safety and proper alignment to receive the metal decking in accordance with Contractor's approved erection procedure.
4. Erect building frame true and level. Erect columns in a manner to allow for movement due to welding shrinkage and thermal expansion and contraction of framing. Check plumbness after erection of each level. Maintain structural stability of frame during erection. Provide temporary bracing where necessary to maintain frame stability and to support required loads, including equipment and its operation.

R. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

S. Shop Drawings for temporary works located within the building envelope shall be submitted to the Engineer of Record for review and approval. Temporary works Shop Drawings shall show fabrication of structural-steel components, including details of

layout and connections, fabrication of all members, and element and erection plans, and erection sequence. Shop Drawings shall identify temporary works members to remain in the permanent structure. Review of Shop Drawings by the Engineer of Record is of a general nature only.

3.7 FIELD CONNECTIONS

- A. Field connection requirements shall be as a minimum equal to those specified in Part 2 of this document.
- B. Erection bolts for welded connection shall be tightened securely and left in place, unless noted otherwise.
- C. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.
- D. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or weld tabs where required by specifications or contract drawings, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
 - 4. Weld in manner to prevent warping or distortion of finished product. Use jigs which will not restrain piece from moving during welding or cooling after welding. Sequence weld passes at a joint to prevent excessive heat build-up or cause shrinkage cracks to form.
 - 5. Auxiliary Member Connections and Temporary Welds shall be per AWS provided that preheating may be omitted on ASTM A36 steel for single pass fillet welds with low hydrogen electrodes under the following conditions: Air temperature is 60 degrees Fahrenheit or over, steel is dry, and welds to structural base material are more than 1" away from corners or ends of plates.
 - 6. Preheat and post-heat procedures for welded joints shall be utilized to prevent rapid cooling of welds, particularly in cold weather. Procedures are Contractor's responsibility.
- E. Shear Studs: The shear studs shall be automatically end welded in accordance with AWS D1.1 and the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plate.
 - 1. There should be no porosity or evidence of lack of fusion between the welded end of the stud and the plate.
 - 2. Shear studs through metal deck shall be welded through the deck within 1 day of laying the deck.

- F. Bearing Pads: Install bearing pads in accordance with manufacturer's recommendations.

3.8 FIELD QUALITY CONTROL

- A. Field quality control shall, as a minimum, conform to the requirements specified under Source Quality Control in Part 2.
- B. Erection Tolerances: Unless otherwise noted, level and plumb individual members of the structure as per AISC 303 Section 7.13 'Erection Tolerances'. Make level and plumb based on the mean operating temperature of the structure, allowing for the difference in temperature at time of erection and the mean temperature of the structure when completed and in service. Base measurements relating to tolerances on the theoretical centerline of the columns.
 - 1. Columns: Gaps exceeding 1/8 inch between milled ends not permitted. Shim acceptable gaps with non-tapered mild steel shim stock.
 - 2. In order to provide a true, flat plane for the exterior elevations, install perimeter steel deck edge closure such that the vertical face does not vary from its intended alignment more than +/- 3/4" at any location.
 - 3. All columns and beams shall adhere to Section M2.7 of the referenced "Specification for Structural Steel for Buildings" which states that completed members shall be free of twists, bends, and open joints. Take special care that column base plates are parallel and perpendicular to faces of columns and that bolt holes are accurately placed.
- C. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- D. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- E. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. The Inspector shall observe all Direct Tension Indicators to see if proper tightness is achieved.
- F. Welded Connections: Field welds will be visually inspected according to AWS D1.1, the governing building code, and Part 2 of this document, by the Testing Agency.
- G. Defective Work:
 - 1. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents. Work deemed defective will be removed from the site at the Contractor's expense.

2. Any special tests not specifically covered by this specification that are proposed by the Contractor as a result of failure to comply with this Section shall be at the Contractor's expense. The Contractor shall be responsible for any consequential costs or delays.
3. The results of those tests will be accepted, at the discretion of the Architect, as proof of adequate materials or workmanship.

3.9 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.
- D. Repair of Openings: For all members exposed to view in the final structure, close all lifting holes, access openings, etc. in such a manner that no visual evidence of the opening remains.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Nonstructural dimension lumber framing.
- C. Sheathing.
- D. Preservative treated wood materials.
- E. Miscellaneous framing and sheathing.
- F. Concealed wood blocking, nailers, and supports.
- G. Drilling, saw cuts, knock-outs and framing for ventilation.
- H. Miscellaneous wood nailers, furring, and grounds.
- I. Steel hardware and attachment brackets

1.3 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- C. Section 06 17 00 – Shop-Fabricated Structural Wood

1.4 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the “Design Criteria Notes” in the structural drawings. If not listed in the “Design Criteria Notes”, use the edition

adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
5. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar. AWPA - Wood Preservative: American Wood-Preservers' Association:
 - a. U1, Use Category System: User Specification for Treated Wood.
 - b. M4, Standard for the Care of Preservative-Treated Wood Products.
7. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
8. AWS D1.1 - Structural Welding Code - Steel.
9. **CBC – California** Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
10. ICC (IECC) - International Energy Conservation Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
11. NDS – National Design Specification for Wood Construction
12. SDPWS - Special Design Provisions for Wind & Seismic
13. PS 1 - Structural Plywood.
14. PS 2 - Performance Standard for Wood Structural Panels.
15. PS 20 - American Softwood Lumber Standard.
16. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber.
17. WCLIB - Standard Grading Rules for West Coast Lumber No. 17.
18. WWPA - Western Lumber Grading Rules.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Certification:
 1. Preservative Treated Wood: Certification for waterborne preservative and that moisture content was reduced to 19 percent maximum, after treatment.
- C. Shop-fabricated structural wood: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if shop-fabricated structural wood is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

1.6 QUALITY ASSURANCE

A. General:

1. Coordinate the work of all trades to ensure proper placement of all materials, anchors, etc., as well as providing for openings and anchors for the installation of surface mounted materials and equipment.
2. Qualifications for Workers: Provide sufficient skilled workers and supervisors who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
3. Rejection: In the acceptance or rejection of rough carpentry, no allowance will be made for lack of skill on the part of the workers.

B. Tests and Inspections:

1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the **CBC** requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and no more than 12 months before start of scheduled welding work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Protection:

1. After delivery, store all materials off the ground, covered, and in such a manner as to ensure proper ventilation and drainage and to protect against damage and the weather. Maintain wood at the maximum moisture levels indicated in Materials Section.

2. Keep all material clearly identified with all grade marks legible; keep all damaged material clearly identified as damaged, and separately store to prevent its inadvertent use. Do not allow installation of damaged or otherwise non-complying material.
3. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.
4. Use all means necessary to protect the installed work and materials of all other trades.
5. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber:
 1. Meet requirements of following minimum grades. All grades shall be per WCLIB Grading Rules No. 17 or WWPA Western Lumber Grading Rules. Species Combination shall be Douglas Fir – Larch. Douglas Fir – Larch (North) and Douglas Fir (South) are not permitted without approval from the structural engineer.
 2. Furnish S4S unless otherwise noted.

2.2 SOURCE QUALITY CONTROL

- A. Grade Mark each piece of lumber. Marking must be done by recognized agency.
 1. Douglas Fir shall bear WCLIB or WWPA grade stamp.
 2. Pressure treated Douglas Fir shall bear AWWPA Quality mark.
- B. Wood Sheathing: Each panel shall be legibly identified as to type, grade and species by APA grade. If plies are spliced, the slope of the scarf shall not be steeper than 1:8. White pockets will not be permitted in face plies.

2.3 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Western Wood Products Association; WWPA or West Coast Lumber Inspection Bureau; WCLIB.
- B. Sizes: Size to conform to rules of governing standard. Sizes shown are nominal unless otherwise noted.
- C. Materials:
 - 1. Dimensional Lumber and Timbers:
 - a. Maximum Moisture Content at Initial Use: As indicated on the Drawings
 - b. Species: As indicated on the Drawings.
 - c. Grade: As indicated on the Drawings.
- D. Maximum Moisture Content "at Initial Use" shall be that point at which nails, screws, bolts, split rings, shear plates or other fasteners or the holes for said fasteners are placed in the wood.
- E. All dimension lumber is assumed to be enclosed in the dry building envelope in the final service condition, unless noted otherwise, and free to dry to moisture content less than 19%.
- F. All studs, plates, joists, rafters and beams 3x and thicker shall be free of heart center in accordance with the specified grading standards.

2.4 DIMENSION LUMBER FOR EXPOSED EXTERIOR APPLICATIONS

- A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
- B. Sizes: Size to conform to rules of governing standard. Sizes shown are nominal unless otherwise noted.
- C. Materials:
 - 1. Dimensional Lumber and Timbers:
 - a. Maximum Moisture Content at Initial Use: As indicated on the Drawings.
 - b. Species: As indicated on the Drawings.
 - c. Grade: As indicated on the Drawings.
- D. All studs, plates, joists, rafters and beams 3x and thicker shall be free of heart center in accordance with the specified grading standards.

2.5 SHOP-FABRICATED STRUCTURAL WOOD

- A. At Contractor's option, shop-fabricated structural wood may be substituted for concealed dimension lumber and timbers.
- B. Shop-fabricated structural wood: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
 - 1. Beams: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published modulus of elasticity, E: 2,000,000 psi, minimum.
 - 2. Products:
 - a. Boise Cascade Company: www.bc.com.
 - b. RedBuilt LLC: www.redbuilt.com.
 - c. Weyerhaeuser Company: www.weyerhaeuser.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.6 WOOD SHEATHING

- A. Floor Sheathing : PS 1 or PS 2 APA rated sheathing.
 - 1. Thickness and Type: As indicated on Drawings.
 - 2. Glue: Exterior
 - 3. Edges: Tongue and groove.
- B. Roof Sheathing : PS 1 or PS 2, APA rated sheathing.
 - 1. Thickness and Type: As indicated on Drawings.
 - 2. Glue: Exterior
 - 3. Edges: Square.
- C. Wall Sheathing : PS 1 or PS 2, APA rated sheathing.
 - 1. Thickness and Type: As indicated on Drawings.
 - 2. Glue: Exterior
 - 3. Edges: Square.
- D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- E. Other Applications:
 - 1. Where indicated on the Architectural Drawings as interior wall backing behind tile and in all toilet rooms behind sheet rock, to be C-C APA rated sheathing with exterior glue. Thickness shall be 5/8-inch at all locations.

2. Flooring: C-C APA Performance rated tongue and groove with exterior glue. Thickness type and grade shall be as indicated on the Drawings.
3. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
4. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
5. Other Locations: PS 1, C-D Plugged or better.

2.7 ACCESSORIES

- A. Rough Hardware Fastenings and Connections: All types including bolts, lag screws, nails, spikes, screws, washers and other rough hardware, of kinds that may be purchased and that require no further fabrication, shall be furnished and installed for all finish and rough carpentry and shall conform to NDS Standards and dimensions. All hardware exposed to weather shall be hot-dipped galvanized per ASTM A153 Standards. All nails used into pressure treated lumber shall be hot-dipped galvanized per ASTM A153 or stainless steel.
1. Common wire nails or spikes shall be used unless noted otherwise on the Drawings. Box nails and sinker nails are not permitted. Vinyl coating is permitted on nails when not exposed to weather. Nails and staples shall conform to requirements of **CBC**.
 2. Bolts: Bolt material shall conform to ASTM A307, Grade A. Bolt dimensions shall conform to ANSI/ASME B18.2.1 with hex head of sizes indicated.
 3. Lag Screws: Lag screws shall conform to ASTM 307, Grade A. All lag screws shall have hex heads where exposed.
 4. Washers: Standard flat washers shall conform to ANSI B18.22.1, Type A, Wide Pattern. Steel plate washers shall be Simpson BP or BPS or equivalent. Malleable iron washers shall be standard malleable iron washers.
 5. Power-Actuated Fasteners: Tempered steel pins with special corrosive resistant plating or coating. Pins shall have guide washers to accurately control penetration. Fastening shall be accomplished by low-velocity piston-driven power activated tool. Pins and tool shall be as manufactured by Hilti Fastening Systems or equivalent. See Drawings for size, type and embedment.
 6. Expansion Anchors: See Section 03 30 00 for anchors to concrete and Section 04 20 00 for anchors to masonry.
 7. Adhesive Anchors: See Section 03 30 00 for anchors to concrete and Section 04 20 00 for anchors to masonry.
 8. Fabricated Metal Timber Framing Connectors: Connectors shall be punched for nailing and bolting. Nails and nailing shall conform to the manufacturer's instructions with a nail provided for each punched hole. All connectors must have specific ICC approval. Types as noted on Drawings are Simpson Strong-Tie. Hardware suppliers other than Simpson shall submit a comparative material list itemizing product designation, load rating and supported member size for review by the enforcement agency and the Structural Engineer.
 - a. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653.

9. Steel Connections and Brackets: ASTM A36 weldable quality, galvanize per ASTM A123 or ASTM A666, Type 304 stainless steel where indicated on the Drawings.
 - a. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth
 - b. Welding: Perform welding in accordance with AWS D1.1.
 10. Anchor Bolts: ASTM F1554 Gr. 36 heavy hex headed anchor rods and ASTM A563 nuts; hot-dip galvanized to meet requirements of ASTM A153, matching washers.
- B. Building Paper: Fed. Spec. UU-B-790a, Type I, Grade B (15 lb. min. unless noted elsewhere).
 - C. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.
 - D. General Purpose Construction Adhesives: Comply with ASTM C557.
 - E. Radiant Barrier: Aluminum radiant barrier; designed for factory laminating to roof sheathing.
 1. Products:
 - a. Louisiana-Pacific Corporation; TechShield: www.lpcorp.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.8 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
 1. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.

- a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat exterior rough carpentry items.
 - c. Treat exposed exterior rough carpentry items, including stairways, balconies, and covered walkways
 - d. Do not use treated wood in direct contact with the ground.
2. Interior Type A: AWP A U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
- a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Interior rough carpentry items are to be fire retardant treated.
 - c. Treat rough carpentry items as indicated.
 - d. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:

- 1. All wood in contact with concrete or masonry shall be preservative treated.
- 2. Preservative Pressure Treatment of Lumber Above Grade: AWP A U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
- 3. Preservative Pressure Treatment of Plywood Above Grade: AWP A U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
 - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
- 4. Preservative Pressure Treatment of Lumber in Contact with Soil: AWP A U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
 - a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.
 - b. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA) in exposed exterior applications subject to leaching.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspection:
 - 1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly proceed.
 - 2. Verify that rough carpentry may be performed in strict accordance with the original design and all pertinent codes and regulations.
- B. Discrepancies: In the event of discrepancy, immediately notify Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- C. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

- A. Protect all work in progress and all work installed, as well as the work of all other trades. Any work damaged as a result of the work under this section shall be corrected to its original condition or replaced if directed by the Architect at no increase in cost to the Owner.
- B. Ventilation: Contractor shall include all labor and materials necessary to provide ventilation requirements of roof overhangs, eaves, attics, and all other components of the building required by codes to be ventilated. Work shall include removing knock-outs in wood I-joists for cross ventilation, drilling of blocking, wood sheathing, and other wooden components of the structure necessary to comply with requirements of the CBC for ventilation of buildings.
- C. Select material sizes to minimize waste.
- D. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- E. General: All rough carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.
- F. Selection of Lumber Pieces: Carefully select all members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections. Cut out and discard all defects which will render a piece unable to serve its intended function.

- G. Lumber may be rejected by the Architect, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.
- H. Shimming: do not shim any framing component.
- I. Care shall be taken that notching and boring of members is in strict conformance with the Drawings and that there are no over-cuts.
- J. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 INSTALLATION - FRAMING AND ROUGH CARPENTRY

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Sills: Shall be in long lengths of sizes shown, fastened with anchor bolts as indicated, a minimum of two anchor bolts per piece. Place steel plate washers (but not standard flat or malleable iron washers) under nuts bearing on wood. Set sills level and true.
- D. Studs, Posts and Columns: Shall be full length. Corners shall be as detailed. Partitions or walls containing plumbing, heating or other piping shall be so formed as to give proper clearance for materials. Cut members as required to provide full bearing at ends. Connect to structure as indicated.
- E. Plates: Shall be full length of wall segment or 12-foot minimum and spliced as shown.
- F. Joists and Beams: Shall be full span length and spliced over bearings unless shown otherwise. Install with crown side up. Beams or headers indicated to be built up of two or more joists shall be fabricated on the job using full length members. For two piece 2x members, stitch nail pieces together with 16d common nails spaced not over 12 inches c.c. and staggered. Clinch nails protruding through members. For three or more piece members, stitch bolt pieces together with ½" bolts spaced not over 12 inches c.c. and staggered.
 - 1. Provide double joists and headers at all openings through roof unless otherwise shown on Drawings.
 - 2. Provide typical headers at all openings through walls where one or more studs are required to be cut. For penetration through walls narrower than stud spacing, provide solid blocking on all sides for fastening finish materials.

3.4 INSTALLATION - BLOCKING, NAILERS, AND SUPPORTS

- A. Blocking: Blocking shall be same thickness and width of studs or joists unless shown otherwise. Blocking shall not be spaced over 8'-0" c.c. Install fire blocking in accordance with **CBC**. Horizontal fire blocking in walls shall be placed at floor lines and ceiling lines unless noted otherwise. Install blocking at all sheathing joints where noted on the Drawings. Install wall width full height solid blocking at floor joists beneath all posts in walls. Blocking shall be installed around all wall, floor and roof penetrations.
- B. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.

3.5 INSTALLATION - SHEATHING

- A. Wood Sheathing: Install to pattern indicated and provide blocking at joints where noted on the Drawings. Center all joints over bearing supports. Nail to framing as indicated. Install wood sheathing with face plies perpendicular to joists unless indicated otherwise. Wall wood sheathing shall continue uninterrupted by ceilings or soffit from floor to floor or floor to roof unless specifically detailed on the Structural Drawings.

3.6 INSTALLATION - FASTENERS

- A. Nailing: Except as otherwise indicated on Drawings or specified, all nailing shall be as required by CBC Table 2304.10.2 - Fastening Schedule.
 - 1. Nails or Spikes shall be common wire unless noted otherwise. Penetration of nails or spikes shall be one-half the length of the nail or spike into the piece receiving the point. However, to connect pieces 2" in thickness, 16d nails shall be used unless noted otherwise.
 - a. Bore holes for nails wherever necessary to prevent splitting.
 - b. Use finish or casing for finish work.
 - c. Use of machine nailing is subject to a satisfactory installation of nails. Minimum edge distances shall be maintained. Nails installed through sheathing with nail guns shall not penetrate into the outer plies deeper than hand nailing. Submittal of guns and nails is required.
 - d. All nailing into Pressure-Treated lumber shall utilize hot-dipped zinc coated galvanized nails or stainless steel nails per **CBC**.

- B. Bolts and Lag Screws: Bolts shall be sizes indicated on Drawings. Holes for bolts shall be 1/16-inch larger than the bolt diameter. Malleable, Steel plate or standard flat washers shall be used where heads or nuts would otherwise bear directly on wood surfaces. Malleable or plate washers shall be used on all anchor bolts. Cut washers are not permitted. Lag screws shall be screwed (not driven) into place. For the shank, holes shall be bored the same depth and diameter as shank. For threaded portion, holes shall be pre-drilled to 50% of the shank diameter, except as follows:
 - 1. 7/8" Diameter Lag Screw: Pre-Drill 1/2" diameter hole.
 - 2. 1" Diameter Lag Screw: Pre-Drill 5/8" diameter hole.
 - 3. Soap Lag screws prior to installation.
 - 4. Tighten all bolts and screws before closing in.
- C. Framing Devices: Install according to the manufacturer's instructions unless otherwise noted.

3.7 INSTALLATION, MISCELLANEOUS

- A. Install all items under other sections specified to be furnished and installed in other sections which relate to the rough carpentry work.
- B. Miscellaneous Carpentry Work not included under other sections but, indicated or required yet not specified elsewhere shall be furnished and installed hereunder, including appropriate fastening devices. Contractor shall provide miscellaneous carpentry work for all sections and divisions of work identified.
- C. Wood Furring, Stripping: Install as shown or required to provide nailing materials or passage of pipes, conduits, etc., not otherwise accommodated including ceiling stripping for gypsum drywall construction.
- D. Bridging: Space not over 8'-0" c.c. for spans over 16'-0". Joists 8 inches or less in depth shall not require bridging unless specifically indicated.
- E. Solid Wood Backing: Solid wood backing shall be provided for all wall and ceiling finishes and for supporting of mounted items for all trades, including but not limited to metal toilet partitions, toilet room accessories, frames, cabinets, casework, mirrors, trim, applied wall finishes, athletic equipment, food service equipment, piping, conduit, ducts, etc. Contractor shall coordinate placement of backing and supports with Subcontractor supplying mounted items.
- F. Building Paper: Install in all locations indicated except where included in other sections of the specifications.
- G. Cant Strips and Crickets: Shape to sizes shown. Rigidly fasten to construction. Form neat mitered corners.
- H. Wood Sheathing Backing: All toilet rooms, restrooms, single or joint occupancy shall have all walls backed with 5/8-inch thick wood sheathing with no surface voids. Install

sheathing between the framing members and wallboard. The same wood sheathing shall also be provided and installed at all tile locations. At tile locations wood sheathing shall be installed between the framing members and the resin-cement backing board.

- I. Wood Curbs for Equipment: Construct all wood curbs for roof mounted equipment as detailed. Provide all miscellaneous blocking, bracing, supports, and other wood items as shown or required to complete the work.
- J. Plywood Backing for Electrical, telephone, and similar types of wall mounted equipment shall be provided hereunder where required. Plywood shall be 3/4-inch thick exterior A-C plywood with 'A' face exposed.
- K. Fire/Draft Stops: Construct fire and drafts stops in furred attic spaces where indicated or required by **CBC** code. Unless otherwise indicated on Drawings construct of not less than 5/8-inch Type 'X' gypsum wallboard or 1/2" wood sheathing, adequately supported by 2x4's at 24 inches c.c., braced diagonally to the roof structure. Draft stop and installation work shall conform to code requirements.
- L. Shoring and Bracing: Shore or brace for temporary support of all work as required during the construction period except any shoring and bracing specified and included under other sections of these specifications.

Temporary Enclosures: Provide and maintain all barricades and enclosures required to protect the work in progress.
- M. Protect all work in progress and all work installed, as well as the work of all other trades. Any work damaged as a result of the work under this section shall be corrected to its original condition or replaced if directed by the Architect at no increase in cost to the Owner.
- N. Ventilation: Contractor shall include all labor and materials necessary to provide ventilation requirements of roof overhangs, eaves, attics, and all other components of the building required by codes to be ventilated. Work shall include removing knock-outs in wood I-joists for cross ventilation, drilling of blocking, wood sheathing, and other wooden components of the structure necessary to comply with requirements of the **CBC** for ventilation of buildings.

3.8 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.9 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.

- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.10 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.11 CLEANING

- A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

3.12 SCHEDULES

- A. Lower Level Floor Joists: MSR Lumber.
- B. Upper Level Floor and Ceiling Joists, Rafters: Spruce-Pine-Fir, No. 2 Grade.
- C. Exposed Beams: Western Cedar, Select Structural Grade.

END OF SECTION

SECTION 061700
SHOP-FABRICATED STRUCTURAL WOOD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Shop-fabricated structural wood (SFSW).
- B. All blocking, bridging, etc., for the installation of members.
- C. Clips, angles, straps, hangers, etc., incidental to installation of members.
- D. Nails, bolts, washers and other fasteners used for erecting and securing members.

1.3 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry.

1.4 REFERENCE STANDARDS

- A. AITC 117 - Standard Specifications for Structural Glued Laminated Timber of Softwood Species.
- B. AITC A190.1 - American National Standard for Wood Products - Structural Glued Laminated Timber.
- C. ASTM D2559 - Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
- D. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. AWPA U1 - Use Category System: User Specification for Treated Wood.
- G. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
- H. AWS D1.1 - Structural Welding Code - Steel.

- I. FM (AG) - FM Approval Guide Current Edition.
- J. NDS – National Design Specification for Wood Construction
- K. SDPWS - Special Design Provisions for Wind & Seismic
- L. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber.
- M. UL (DIR) - Online Certifications Directory Current Edition.
- N. UL (FRD) - Fire Resistance Directory Current Edition.
- O. WCLIB - Standard Grading Rules for West Coast Lumber No. 17.
- P. WWPA - Western Lumber Grading Rules.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials, application technique and resultant performance information.
- C. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, and framed openings.
 - 1. Show large scale details of connections, connectors and other accessories.
 - 2. Indicate species and laminating combination, adhesive type, and other variables in required work.
- D. Manufacturer's Qualification Statement.

1.6 QUALITY ASSURANCE

- A. Manufacturing facility shall be approved by an independent inspection agency approved by the International Accreditation Service, Inc. (IAS).
- B. Each Shop-fabricated structural wood member shall be stamped with an identifying mark. Mark shall include all pertinent data, such as grade and species of lumber, plant number, independent inspection agency, logo, ICC ES report number and other such information as may be required.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver undamaged products to site in manufacturer's protective wrappings with legends intact. Store on site secure from weather, soil and physical damage.
- B. Transport, handle and store in strict accordance with the manufacturer's recommendations. Use padded, non-marring slings.

- C. Architectural Appearance Grade members shall be shipped, handled and stored with complete weather and damage protection wrapping. Maintain wrappings in place until immediately prior to deck installation.
- D. Industrial Appearance Shop-fabricated structural wood members shall be wrapped in a water resistant covering during transit. Contractor shall be responsible for protection during hauling and unloading at job site.
- E. If members must be stored prior to erection, they shall be stored in a vertical position off the ground, covered and protected from weather.
- F. Protect members to AITC requirements for not wrapped.
- G. Leave individual wrapping in place until finishing occurs.
- H. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 - PRODUCTS

2.1 SHOP-FABRICATED STRUCTURAL WOOD (SFSW)

- A. SFSW members shall be of the types and sizes indicated on Drawings and as specified here. Shop-fabricated structural wood shall have specific ICC approval, and shall meet all specified structural design properties. Proposed SFSW members may be used only if equivalent, in the Architect's opinion, to the SFSW specified.

2.2 MATERIALS

A. Lumber:

1. Laminated Veneer Lumber (LVL): LVL shall be manufactured in accordance with the manufacturer's ICC-ES Report and have properties equal to or greater than as specified on the Drawings. Lumber species, thickness, etc. shall be such that the nailing capacity is equal to or better than that specified.
2. Parallel Strand Lumber (PSL): PSL shall be manufactured in accordance with the manufacturer's ICC-ES Report and have properties equal to or greater than as specified on the Drawings. Lumber species, thickness, etc. shall be such that the nailing capacity is equal to or better than that specified.
3. Laminated Strand Lumber (LSL): LSL shall be manufactured in accordance with the manufacturer's ICC-ES Report and have properties equal to or greater than as specified on the Drawings. Lumber species, thickness, etc. shall be such that the nailing capacity is equal to or better than that specified.
4. Various SFSW products shall only be used where specifically indicated on the Drawings. No substitutions shall be made without written approval.

B. Adhesive:

1. According to manufacturers ICC ES Report.

- C. Types:
 - 1. Sizes, properties and additional information as shown on the Drawings.
- D. Laminating Adhesive: Tested for wet/exterior service in accordance with ASTM D2559.

2.3 FABRICATION

- A. Fabrication shall be in compliance with manufacturer's ICC ES Report.
 - 1. Fabrication shall be in accordance with best practices with adequate plant equipment and under supervision of properly qualified personnel.
 - 2. Moisture content of components at time of gluing shall comply with the manufacturer's ICC ES Report.
- B. Boring of holes in members shall be in strict conformance with the Drawings. Notching is prohibited except where specifically detailed.
- C. Verify dimensions and site conditions prior to fabrication.
- D. Cut and fit members accurately to length to achieve tight joint fit.
- E. Field cuts and holes in preservative treated members shall be preservative treated and sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of the work of this Section, carefully inspect and verify that the installed work of all other trades is complete to the point where this installation may properly commence.
- B. Verify that specified items may be installed in accordance with the approved design.
- C. In the event of a discrepancy, immediately notify Architect. Do not proceed in discrepant areas until discrepancies have been fully resolved.

3.2 PREPARATION

- A. Coordinate placement of bearing items.

3.3 PROTECTION

- A. Protect work and materials of this Section prior to and during installation, and protect the installed work and materials of other trades.

- B. In the event of damage, make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.

3.4 HANDLING

- A. Use equipment and methods that avoid damages that may impair strength of SFSW members. Sharp instruments and unprotected wire rope, chain slings and the like shall not be permitted.

3.5 ERECTION

- A. Shop-fabricated structural wood members are to be erected and installed in accordance with the Drawings and manufacturer's recommendations.
- B. Set structural members level and plumb, in correct positions or sloped where indicated.
- C. Provide temporary bracing and anchorage to hold members in place until permanently secured.
- D. Fit members together accurately without trimming, cutting, splicing, or other unauthorized modification.
- E. Swab and seal the interior wood surfaces of field drilled holes in members with primer.

3.6 TOLERANCES

- A. Framing Members: 1/2 inch maximum from true position.

3.7 CLEANUP

- A. Keep premises free from accumulated waste materials, rubbish and debris resulting from this work. Upon completion, remove tools, appliances, surplus materials, waste materials, rubbish, debris and accessory items used in or resulting from said Work, and legally dispose of off the site.

END OF SECTION

SECTION 071326
SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Blindside sheet waterproofing.
3. Accessory waterproofing system materials.
4. Molded-sheet drainage panels.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

- A. Compatible: Material that will not adversely affect adjacent materials, is chemically compatible with adjacent materials, and where required for bond, achieves adhesive compatibility with adjacent materials.
- B. Chemical Compatibility: Material that will not break down, deteriorate, degrade, or prematurely fail when in contact with another material. Material that will not cause chemical breakdown, deterioration, degradation, staining, or premature failure of another material.
- C. Adhesive Compatibility: Material that will develop bond strength or provide a suitable surface for another material to develop bond strength complying with requirements when in contact with another material.

1.3 COORDINATION

- A. Coordinate Work under this Section with adjacent concrete foundation work, including fill, other waterproofing systems , under-slab vapor retarders.
- B. Coordinate requirements for concrete formwork to provide suitable substrate for waterproofing and to minimize penetrations through waterproofing.
- C. Coordinate formwork and form bracing requirements for blindside sheet waterproofing. Coordinate restrictions on use of form ties and other components as necessary to eliminate or minimize penetrations through blindside sheet waterproofing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written installation instructions for evaluating, preparing, and treating substrate.
- B. Samples: For the following materials:
 - 1. 8-by-8-inch square of waterproofing and flashing sheet.
 - 2. 4-by-4-inch square of drainage panel.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and certified by waterproofing manufacturer.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to frozen, damp, or wet substrates.
 - 1. Do not apply waterproofing when snow, rain, fog, or mist is present.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Manufacturer's Special Warranty:
 - 1. Waterproofing Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - a. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Waterproofing System: Obtain waterproofing materials and molded-sheet drainage panels from same manufacturer as waterproofing membrane.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet Waterproofing, Fabric Reinforced: Minimum 60-mil nominal thickness, self-adhering sheet consisting of rubberized-asphalt membrane with embedded fabric reinforcement, and with release liner on adhesive side.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Coatings and Waterproofing, Inc.; MiraDri or comparable product by one of the following:
 - a. Protecto Wrap Company
 - b. Royston
 - c. W. R. Meadows, Inc
 2. Physical Properties:
 - a. Pliability: No cracks when bent 180 degrees over a 1-inch mandrel at minus 45 deg F; ASTM D146/D146M.
 - b. Puncture Resistance: [40 lbf][100 lbf] 60 lbminimum; ASTM E154/E154M.
 - c. Water Vapor Permeance: 0.09 perm maximum; ASTM E96/E96M, Water Method.
 3. Sheet Strips: Self-adhering, reinforced, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 BLINDSIDE SHEET WATERPROOFING

- A. Blindside Sheet Waterproofing for Vertical Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly; with the physical properties as specified below:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Coatings and Waterproofing, Inc; MiraPly or comparable product by one of the following:
 - a. AVM Industries, Inc
 - b. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
 - c. Soprema, Inc.
 2. Physical Properties:
 - a. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
 - b. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D903, modified.
 - c. Lap Adhesion: 5 lbf/in. minimum; ASTM D1876, modified.
 - d. Hydrostatic-Head Resistance: 231 ft.; ASTM D5385/D5385M, modified.
 - e. Puncture Resistance: 300 lbf minimum; ASTM E154/E154M.
 - f. Water Vapor Permeance: 0.09 perm maximum; ASTM E96/E96M, Water

Method.

- g. Ultimate Elongation: 500 percent minimum; ASTM D412, modified.

- B. Blindside Sheet Waterproofing for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly; with the physical properties as specified below:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AVM Industries, Inc
 - b. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
 - c. Soprema, Inc.
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Coatings and Waterproofing, Inc; MiraPly or comparable product by one of the following:
 - a. AVM Industries, Inc
 - b. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
 - c. Soprema, Inc.
- 3. Physical Properties:
 - a. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
 - b. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D903, modified.
 - c. Lap Adhesion: 5 lbf/in. minimum; ASTM D1876, modified.
 - d. Hydrostatic-Head Resistance: 231 ft.; ASTM D5385/D5385M, modified.
 - e. Puncture Resistance: 300 lbf minimum; ASTM E154/E154M.
 - f. Water Vapor Permeance: 0.1 perm maximum; ASTM E96/E96M, Water Method.
 - g. Ultimate Elongation: 335 percent minimum; ASTM D412, modified.

- C. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

2.4 ACCESSORY WATERPROOFING SYSTEM MATERIALS

- A. General: Accessory materials as recommended in writing by waterproofing manufacturer for intended use and compatibility with one another and with sheet waterproofing.
 - 1. Furnish liquid-type accessory materials that comply with VOC limits of authorities having jurisdiction.

- B. Primer: Liquid waterborne primer as recommended in writing for substrate by sheet waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner as recommended in writing for substrate by waterproofing manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity as recommended in writing for substrate by waterproofing manufacturer.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating as recommended in writing for substrate by waterproofing manufacturer.
- F. Metal Termination Bars: Manufacturer's standard aluminum or stainless steel bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.
- G. Joint Sealant: Single-component polyurethane sealant, compatible with waterproofing; as specified in Section 079200 "Joint Sealants"; and as recommended in writing by waterproofing manufacturer for substrate and joint conditions.
- H. Backer Rod: Closed-cell polyethylene foam.

2.5 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panels: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 95 gpm per ft. sq..
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Coatings and Waterproofing, Inc; CCW MiraDRAIN 9800 or comparable product by one of the following:
 - a. American Hydrotech, Inc.
 - b. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
 - c. Soprema, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time recommended in writing by waterproofing manufacturer.

2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by waterproofing manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates in accordance with waterproofing manufacturer's written installation instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks in accordance with ASTM D4258.
1. Install sheet strips of width in accordance with waterproofing manufacturer's written installation instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- C. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths in accordance with waterproofing manufacturer's written installation instructions.
1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- D. Corners: Prepare, prime, and treat inside and outside corners in accordance with waterproofing manufacturer's written installation instructions.
1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
 - b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.
- E. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION OF MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Install modified bituminous sheets in accordance with waterproofing manufacturer's written installation instructions.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align

sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet waterproofing terminations with termination bar and sealant.
- G. Roll waterproofing membrane to firmly adhere to substrate. Roll seams and terminations.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

3.4 INSTALLATION OF BLINDSIDE SHEET WATERPROOFING

- A. Install blindside sheet waterproofing in accordance with waterproofing manufacturer's written installation instructions.
- B. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity.
- C. Vertical Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation. Mechanically fasten to substrate.
 1. Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detail tape.
 2. Ensure transition with other waterproofing membrane.
- D. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by waterproofing manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- E. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- F. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.

- G. Install sheet waterproofing and accessory materials to produce a continuous watertight tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.5 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, in accordance with manufacturer's written installation instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a part-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.
 - 1. Final Inspection: Arrange for waterproofing system manufacturer's technical personnel to inspect system installation on completion, in presence of Architect, and to prepare inspection report.
 - 2. Notify Architect and Owner 48 hours in advance of date and time of inspection.
 - 3. Repair or remove and replace components of waterproofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional Tests and Inspections:
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
 - 2. Waterproofing system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 PROTECTION, REPAIR, AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and

procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 072100 THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyisocyanurate foam-plastic board insulation.

B. Related Requirements:

1. Division 07 Sections as applicable to membrane roofing systems where rigid board insulation is installed as part of the roof system..

1.2 ACTION SUBMITTALS

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

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

- B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class A, 25 and 450 when tested in accordance with ASTM E84.
- B. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

- C. Thermal-Resistance Value (R-Value): R-value as indicated below in accordance with ASTM C518.

- 1. R-Value at Roof: 30 R-value min.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

- A. Polyisocyanurate Board Insulation, Glass-Fiber-Mat Faced: ASTM C1289, glass-fiber-mat faced, Type II, Class 2.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Atlas Polyiso Roof and Wall Insulation
 - b. Carlisle Coatings & Waterproofing Inc
 - c. Hunter Panels; a Carlisle company
 - d. Johns Manville; a Berkshire Hathaway company
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville or comparable product by one of the following:
 - a. Atlas Polyiso Roof and Wall Insulation
 - b. Carlisle Coatings & Waterproofing Inc
 - c. Hunter Panels; a Carlisle company
 - d. Johns Manville; a Berkshire Hathaway company

2.3 INSULATION FASTENERS

- A. Insulation Fastener Accessories: Provide double-pointed weld pins, lagging pins, quilting pins, duct liner pins, insulation hangers, specialty washers, special caps, j-hooks, capacitor discharge annular weld pins, capacitor discharge acoustical lagging pins, and other accessory materials that are recommended in writing by insulation fastener manufacturer to produce complete insulation supports.

2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Miscellaneous Application Accessories:
 - 1. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation

- securely to substrates without damaging insulation and substrates.
2. Crack Sealer: Closed-cell insulating foam in aerosol dispenser recommended in writing by insulation manufacturer for filling gaps in board insulation.
 3. Detailing Foam Insulation for Voids: Urethane foam complying with AAMA 812, low expansion pressure suitable for filling insulation gaps and voids adjacent to openings to protect against water, air, and sound intrusion.
 4. Tapes for Reflective Insulation and Barriers:
 - a. As recommended in writing by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or those that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF BOARD INSULATION

- A. Install board insulation in accordance with manufacturer's written instructions per project applications and conditions.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and

cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 072600
VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Polyethylene vapor retarders.
2. Reinforced-polyethylene vapor retarders.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D4397, 10-mil- thick sheet, with maximum permeance rating of 0.03 perm.

2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on underside of slab.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION

SECTION 075419
POLYVINYL-CHLORIDE (PVC/TPA) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered thermoplastic PVC roofing system on wood deck, including:
2. Roof insulation.
3. Roof insulation cover board.
4. Walkway material.

B. Related Sections:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers and blocking.
2. Division 07 Section "Preparation for Re-Roofing" for recover board beneath new membrane roofing.
3. Division 07 Section "Air Barrier Rehabilitation" for requirements for sealing of air barrier at perimeter of roofing and within roofing system.
4. Division 07 Section "Sheet Metal Flashing and Trim" for shop-formed sheet metal items including roof drainage system items, roof penetration flashings, base and counterflashings and reglets, and formed copings and roof edge metal items.
5. Division 07 Section "Roof Specialties" for manufactured copings, roof edge flashings and counterflashings, and roof edge drainage systems.
6. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 "Standard Terminology Relating to Roofing and Waterproofing" and applicable edition of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" and NRCA's Glossary for definition of terms related to roofing work in this Section.
- B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.

- C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review drawings and specifications.
3. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
5. Examine substrate conditions and finishes for compliance with requirements, including flatness and fastening.
6. Review structural loading limitations of roof deck during and after roofing.
7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
8. Review governing regulations and requirements for insurance and certificates if applicable.
9. Review temporary protection requirements for roofing system during and after installation.
10. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. SDS: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Approval Certificate.
 1. Include letter from Manufacturer written for this Project indicating approval of Installer.

B. Qualification Data: For Roofing Inspector.

1. Include a notarized letter from a corporate officer of the manufacturer stating that a manufacturer-employed inspector will provide three days per week jobsite inspections for the duration of the project.
2. Provide three sample job site inspection reports used on previous projects.
3. Provide five references of projects where three days per week jobsite inspections were performed by the manufacturer. Include customer name, point of contact, phone number and email address.

C. Warranties: Unexecuted sample copies of special warranties.

D. Inspection Reports: Reports of Roofing Inspector. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.

1. Submit reports within 48 hours after inspection.

E. Manufacturer's Instructions: Submit copy of manufacturer's written installation instructions for specified roofing system.

1.6 CLOSEOUT SUBMITTALS

A. Executed copies of warranties.

B. Maintenance Data: To include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of five years' experience installing products comparable to those specified, able to communicate verbally with Contractor, and employees, and qualified by the manufacturer to install manufacturer's product and furnish warranty of type specified.

B. Manufacturer Qualifications:

1. Be nationally recognized in roofing and waterproofing industry for at least ten (10) years.
2. Single Ply Membrane must meet or exceed the California Energy Commission's Title 24 requirements for reflectance and emissivity adopted for 2005. Product must be tested and approved by the Cool Roof Rating Council.
3. Provide local Field Representative to make periodic site visits, report work quality and job progress.
4. Provide list of at least three (3) projects available for inspection employing same

system(s) within the last three (3) years, within the same climate zone and 50 mile distance of project building(s).

5. Be approved by District
6. Provide independent laboratory test results for all roofing materials using ASTM test criteria as designated in Part 2 – Product section of this specification indicating compliance with the performance criteria contained herein.
7. The presence and activity of the manufacturer's representative and/or District's representative shall in no way relieve the roofing contractor of his/her contractual liabilities/responsibilities.
8. Provide to the district names of at least three (3) qualified roofing applicators/installers
9. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.
10. Approved manufacturers must meet separate requirements of Submittals Article.

C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:

1. An authorized full-time technical employee of the manufacturer.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site access to manufacturer's written recommendations and instructions for installation of products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.9 PROJECT / FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
 - 1. Provide tie-offs at end of each day's work to cover exposed roofing and insulation with a course of roofing sheet securely in place with joints and edges sealed.
 - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
 - 3. Remove temporary plugs from roof drains at end of each day.
 - 4. Remove and discard temporary seals before beginning work on adjoining roofing.

1.10 WARRANTY

- A. Warranty, General: Warranties specified shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Manufacturer's Warranty: Manufacturer's standard or customized form, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
 - 1. Manufacturer's warranty includes roofing membrane, base flashings, fasteners, roofing membrane accessories and other components of roofing system specified in this Section.
 - 2. Warranty documents that exclude components not supplied by the manufacturer are not acceptable to the Owner.
 - 3. Warranty document will not exclude damaged from windspeeds below 74 MPH.
 - 4. Warranty Period: 20 years from date of Substantial Completion.
- C. Installer's Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section and related Sections indicated above, including all components of membrane roofing such as single ply roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.
- D. Manufacturer Inspection Services: By manufacturer's technical representative, to report maintenance responsibilities to Owner necessary for preservation of Owner's warranty rights. The cost of manufacturer's inspections is included in the Contract Sum.
1. Inspections to occur in following years: 2, 5, 10 and 15 following completion.
 2. Inspections include rooftop housekeeping, including removal of incidental debris (such as leaves, branches, paper and similar items) from the roof membrane and drainage areas such as gutters. All debris will be disposed of at the Owner's approved on-site location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: The roof system specified in this Section is based upon products of Tremco CPG Inc, Beachwood, OH, (800) 562-2728, www.tremcoroofing.com that are named in other Part 2 articles. Provide specified products.
1. Manufacturers of comparable products: Approved by Architect prior to bid.
- B. Source Limitations: Obtain components for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
1. Accelerated Weathering: Roofing system shall withstand 10,000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency in accordance with ANSI/FM 4474, UL 580, or UL 1897, and to resist uplift pressures calculated in accordance with ASCE-7 and applicable code.
- C. Flashings and Fastening: Comply with requirements of Division 07 Sections "Sheet Metal Flashing and Trim" and "Roof Specialties." Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:

1. NRCA Roofing Manual (Sixth Edition) for construction details and recommendations.
 2. SMACNA Architectural Sheet Metal Manual (Seventh Edition) for construction details.
- D. Exterior Fire-Test Exposure: ASTM E108 or UL790, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.
- F. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

2.3 MATERIALS, GENERAL

- A. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

2.4 THERMOPLASTIC MEMBRANE MATERIALS

- A. PVC Roof Membrane:
1. Thermoplastic PVC/TPA sheet, internally fabric reinforced and fleece backed, Energy Star qualified, CRRC listed, and California Title 24 Energy Code compliant, ASTM D4434 Type IV.
 - a. Basis of design product: Tremco, TPA FB Single Ply Roof Membrane.
 - b. Tensile Strength at 0 deg. F (-18 deg. C), minimum, ASTM D751: 350 lbf/in (1550 N).
 - c. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D751: 100 lbf (440 N).
 - d. Elongation at 0 deg. F (-18 deg. C), minimum at fabric break, ASTM D751: 35 percent machine direction, 33 percent cross-machine direction.
 - e. Minimum Thickness, nominal, ASTM D751: 0.060 in (1.5 mm).
 - f. Color: White.
 - g. Solar Reflectance Index (SRI), ASTM E1980: 108 (White, initial); 84 (White, 3-year aged).
 - h. Recycled Content, minimum: 25 percent pre-consumer.

- B. Membrane Flashing: Manufacturer's standard, smooth-backed, sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.

2.5 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Single-Ply Roof Membrane Sealants: 450 g/L.
 - c. Nonmembrane Roof Sealants: 300 g/L.
 - d. Sealant Primers for Nonporous Substrates: 250 g/L.
 - e. Sealant Primers for Porous Substrates: 775 g/L.
 - 3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Membrane Adhesive:
 - 1. Bonding adhesive, water-based low-VOC, for bonding TPA fleece-backed and TPO fleece-backed single ply membranes and flashings to substrates.
 - a. Basis of design product: Tremco, Fleece Back WB Single Ply Bonding Adhesive.
 - b. VOC, maximum, ASTM D3960: 178 g/L.
- C. Flashing Membrane Adhesive:
 - 1. Bonding adhesive, contact-type solvent-based low VOC, for bonding TPA non-fleece-backed single ply membranes and flashings to substrates.
 - a. Basis of design product: Tremco, TPA LV Single Ply Bonding Adhesive.
 - b. VOC, maximum, ASTM D3960: 200 g/L.

- D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 mm by 3 mm) thick; with anchors.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to membrane roofing system manufacturer.
- F. Joint Sealant: Elastomeric joint sealant compatible with roofing materials, with movement capability appropriate for application.
 - 1. Joint Sealant, Polyurethane: ASTM C920, Type S, Grade NS, Class 50 single-component moisture curing sealant, formulated for compatibility and use in dynamic and static joints; paintable.
 - a. Basis of design product: Tremco, TremSEAL Pro.
 - b. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 40 g/L.
 - c. Hardness, Shore A, ASTM C661: 40.
 - d. Adhesion to Concrete, ASTM C794: 35 pli.
 - e. Tensile Strength, ASTM D412: 350 psi (2410 kPa).
 - f. Color: White.
- G. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.6 ROOF INSULATION MATERIALS

- A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from insulation manufacturer's standard sizes, suitable for application, and of thicknesses indicated.
 - 1. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, not less than two times the roof slope.
- B. Roof Insulation: Provide roof insulation product in thicknesses indicated in Part 3 as follows:
 - 1. Board Insulation, Polyisocyanurate: CFC- and HCFC- free, with recycled content glass-fiber mat facer on both major surfaces, ASTM C1289 Type II Class 1.
 - a. Basis of design product: Tremco, Trisotech Insulation or equal.
 - b. Compressive Strength, ASTM D1621: Grade 2: 20 psi (138 kPa).

- c. Conditioned Thermal Resistance at 75 deg. F (24 deg. C): 14.4 at 2.5 inches (50.8 mm) thick.

2.7 ROOF INSULATION ACCESSORIES

A. Cover Board:

- 1. Gypsum panel, glass-mat-faced, primed, ASTM C1177/C1177M.
 - a. Basis of design product: Tremco/GP Gypsum DensDeck Prime or equal.
 - b. Thickness: 1/2 inch (12 mm).

B. Roof Insulation Adhesive:

- 1. Urethane adhesive, bead-applied, low-rise two-component solvent-free low odor, formulated to adhere roof insulation to substrate.
 - a. Basis of design product: Tremco, Low Rise Foam Insulation Adhesive or equal.
 - b. Flame Spread Index, ASTM E84: 10.
 - c. Smoke Developed Index, ASTM E84: 30.
 - d. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 0 g/L.
 - e. Tensile Strength, minimum, ASTM D412: 250 psi (1720 kPa).
 - f. Peel Adhesion, minimum, ASTM D903: 17 lbf/in (2.50 kN/m).
 - g. Flexibility, 70 deg. F (39 deg. C), ASTM D816: Pass.

C. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

D. Insulation Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that substrate is sound and dry.
 4. Wood Roof Deck: Verify that deck shows no signs of damage, rot or deterioration, and is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSTALLATION, GENERAL

- A. Install roofing system in accordance with manufacturer's written instructions and approved details.
- B. Install wood cants, blocking, curbs, and nailers in accordance with requirements of Division 06 Section "Miscellaneous Rough Carpentry."
- C. NRCA Installation Details: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations; modify as required to comply with manufacturer's approved details and perimeter fastening requirements of FM Global references if applicable.

3.4 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Crickets: Install tapered insulation under area of roofing to conform to slopes indicated.

1. Where crickets are indicated or required to provide positive slope to drain, make slope of crickets minimum of two times the roof slope, not less than 1/4 inch in 12 inches (1:48).
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (70 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
1. Flat Insulation System on Sloped Roof Deck: Install insulation at minimum thickness as follows:
 - a. Minimum total thickness of Continuous Insulation: 6 inches.
- E. Insulation Drain Sumps: Tapered insulation sumps, not less than 2 by 2 ft. (600 by 600 mm), sloped to roof drain.
1. Sump to maximum depth of not more than 1 inch (25 mm) less than the Project-stipulated continuous insulation thickness based upon code requirements.
- F. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- H. Mechanically Fastened and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 2. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
- I. Cover Boards: Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together.
1. Secure cover boards to resist uplift pressure at corners, perimeter, and field of roof.
 2. Adhere cover boards by setting in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining cover board in place.

3.5 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Water-Based Bonding Adhesive: Apply to substrate at rate required by manufacturer. Install membrane immediately into adhesive, avoiding any air entrapment; do not allow adhesive to dry. Roll membrane into wet adhesive. Do not apply adhesive to splice area of membrane.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Welded Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- I. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition. Install in such a manner as to not void warranty of existing membrane roofing system.

3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Seal top termination of base flashing with a metal termination bar and a continuous bead of joint sealant.

3.7 FIELD QUALITY CONTROL

- A. Roofing Inspector: Contractor shall engage a qualified roofing inspector to perform roof tests and inspections and to prepare test reports.
 - 1. Engage a qualified roofing inspector for a minimum of 3 full-time days on site, per 40-hour crew week, to perform roof tests and inspections and to prepare start up, interim, and final reports. Roofing Inspector's quality assurance inspections shall comply with applicable criteria established in NRCA's "Quality Control and Quality-assurance Guidelines for the Application of Membrane Roofing Systems."
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075419

SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Custom flashing and trim fabrications, made from the following:
 - 1. Sheet metal materials.
 - 2. Miscellaneous materials.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.
- D. Samples for Verification: Actual sample of finished products for each type of exposed finish for sheet metal and other metal accessories.
 - 1. Sheet Metal Flashing and Trim: Manufacturers' standard size. Include finished seam with required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Entity that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified

Roofing Foreman or installers who are NRCA ProCertified Architectural Metal Flashings and Accessories Installers.

- C. For roof edge flashings and copings that are ANSI/SPRI/FM 4435/ES-1 tested shop is to be listed as able to fabricate required details as tested and approved.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.6 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 SHEET METAL MATERIALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - 1. Nominal Thickness: 0.052 inch.
 - 2. Surface: Smooth, flat.
 - 3. Exposed Coil-Coated Finish:
 - a. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
 - 4. Color: As selected by Architect from manufacturer's full range.
 - 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- C. Aluminum Sheet: Coil-coated sheet, ASTM B209/B209M, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - 1. Thickness: 0.040 inch.
 - 2. Surface: Smooth, flat.
 - 3. Exposed Coil-Coated Finish:

- a. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
- 4. Color: As selected by Architect from manufacturer's full range.
- 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- 6. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- 7. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - a. Color: As selected by Architect from full range of industry colors and color densities.
 - b. Color Range: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 8. As-Milled Finish: Mill.
- D. Zinc Sheet: 99.995 percent electrolytic high-grade zinc with alloy additives of copper (0.08 to 0.20 percent), titanium (0.07 to 0.12 percent), and aluminum (0.015 percent); with manufacturer's standard factory-applied, flexible, protective back coating.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Artazn LLC
 - b. Rheinzink America
 - 2. Thickness: 0.048 inch.
 - 3. Finish: Bright rolled.
- E. Lead Sheet: ASTM B749 lead sheet.
 - 1. Thickness: 4 lb

2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
 3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cheney Flashing Company
 - b. Fry Reglet Corporation
 - c. Hohmann & Barnard, Inc
 2. Material: Aluminum, 0.024 inch thick.
 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 5. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

6. Finish: With manufacturer's standard color coating.

2.4 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 ft. on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams:
 1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- G. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
 3. Aluminum: 0.032 inch thick.
- B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes and built-in overflows. Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
 3. Aluminum: 0.032 inch thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Counterflashing: [**Shop fabricate interior and exterior corners.**] Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
 3. Aluminum: 0.032 inch thick.
- B. Flashing Receivers: Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
 3. Aluminum: 0.032 inch thick.
- C. Roof-Penetration Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.
 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12 ft. long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:
1. Zinc: 0.032 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrates, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.2 INSTALLATION OF SHEET METAL FLASHING AND TRIM, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal

standard.

1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 ft. with no joints within 24 inches of corner or intersection.
 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in zinc where necessary for strength.

3.3 INSTALLATION OF SLOPED ROOF SHEET METAL FABRICATIONS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
 - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
 - 2. Extend counterflashing 4 inches over base flashing.
 - 3. Lap counterflashing joints minimum of 4 inches.
 - 4. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.4 INSTALLATION OF WALL SHEET METAL FABRICATIONS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.
- C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry".

3.5 INSTALLATION OF MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing:
 - 1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
 - 2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 INSTALLATION TOLERANCES

- A. Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 ft. on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

- A. Clean off excess sealants.

3.8 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Latex joint sealants.

B. Related Requirements:

1. Section 079100 "Preformed Joint Seals" for preformed compressible foam and precured joint seals.
2. Division 04 Section "Concrete Unit Masonry" for masonry control and expansion joint fillers and gaskets.
3. Division 32 Section "Concrete Paving Joint Sealants" for exterior concrete paving joint sealants

1.2 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.3 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content: Sealants and primers applied at the Project site shall comply with VOC limits of authorities having jurisdiction; VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); and VOC limits of the California Green Building Standards Code (CGBSC), Section 5.504.4.1 and Table 504.4.2 as follows:
 - 1. Architectural Sealants: 250 g/L
 - 2. Sealant Primers for Porous Substrates 775 g/L
 - 3. Sealant Primers for Nonporous Substrates: 250 g/L
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. Stain-Test-Response Characteristics: Where sealants are indicated to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are used in areas of food preparation, use products that comply with 21 CFR 177.2600 and are USDA approved.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.

- b. Sika Corporation - Building Components
 - c. Tremco Incorporated
- B. Silicone, Acid Curing, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sika Corporation - Building Components
 - b. The Dow Chemical Company
 - c. Tremco Incorporated

2.4 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

2.5 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Sherwin-Williams Company (The)
 - b. Sika Corporation - Building Components
 - c. Tremco Incorporated
- B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation
 - b. Polymeric Systems, Inc.; PPG Industries, Inc.
 - c. Sherwin-Williams Company (The)

2.6 IMMERSIBLE JOINT SEALANTS

- A. Immersible Joint Sealants: Suitable for immersion in liquids; ASTM C1247, Class 1;

tested in deionized water unless otherwise indicated.

2.7 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Sika Corporation - Building Components
 - c. Tremco Incorporated

2.8 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation
 - b. Sherwin-Williams Company (The)
 - c. Tremco Incorporated

2.9 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.10 MISCELLANEOUS MATERIALS

- A. Primer: Material 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.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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 performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means

that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

- a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings 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 sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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 in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Install sealant to depths as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of bead:

1. For sidewalks, pavements and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width, but neither more than 5/8 inch deep nor less than 3/8 inch deep.
 2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
 3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in range of 75 to 125 percent of joint width.
- G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 4. Provide flush joint profile at locations indicated on Drawings in accordance with Figure 8B in ASTM C1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings in accordance with Figure 8C in ASTM C1193.
- a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - a. Extent of Testing: Test completed and cured sealant joints as follows:
 - 1) Perform 10 tests for the first 1000 ft of joint length for each kind of sealant and joint substrate.
 - 2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
 - b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

- c. Inspect tested joints and report on the following:
 - 1) Whether sealants filled joint cavities and are free of voids.
 - 2) Whether sealant dimensions and configurations comply with specified requirements.
 - 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- C. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081613
FIBERGLASS DOORS & FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and installation of FRP doors & frames
- B. Related Requirements:
 - 1. Section 042200 "Concrete Unit Masonry"
 - 2. Section 051200 "Structural Steel Framing"
 - 3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
 - 4. Section 087100 "Door Hardware"

1.2 DEFINITIONS

- A. FRP: Fiberglass Reinforced Polyester

1.3 COORDINATION

- A. Coordinate Work under this Section with other related sections and requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties.
- B. Samples: For the following materials:
 - 1. Frame.
 - 2. Door Panel.

1.5 QUALITY ASSURANCE

- A. Experience: Manufacturer shall be engaged in the manufacture of FRP door and frame systems for a minimum of twenty-five (25) years documented experience prior to the start of this work.
- B. Process: Certify that FRP doors are manufactured via press-molding technology.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. FRP doors and frames are to be delivered to jobsite in adequate crating with foam sheet separations between all components.
- B. Upon receipt of shipment, remove and inspect the doors and frames for damage. Note any damage on the shipping papers prior to acceptance.
- C. Handling and storage of the doors and frames after receipt is the responsibility of the contractor. It is recommended that the doors be stored indoors in a vertical position, clear of the floor, with blocking between the doors to permit air circulation between the doors and prevent damage to the door faces. Rain/water or condensation must not be allowed to collect or lay between stored doors. Do not wrap in plastic sheeting.
- D. Use care in handling FRP doors and frames to prevent damage to factory finishes. Wear protective gloves and do not slide or drag doors and frames against one another or adjacent surfaces.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate installation of anchorages for heavy duty frames per manufacturers requirements. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation.

1.9 WARRANTY

- A. Manufacturer's Warranty:
 - 1. Heavy Duty doors are guaranteed for the life of the product against delamination and failure due to corrosion from the specific chemical environment named at the time of purchase.
 - 2. All products are inspected prior to shipment and guaranteed against defective workmanship for a period of ten (10) calendar years after the date of purchase.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain doors and frames from same manufacturer.

2.2 FRP DOORS & FRAMES

A. Heavy Duty FRP Doors

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tiger Door; Heavy Duty FRP Door or comparable product by one of the following:
 - a. ChemPruf
2. Physical Properties:
 - a. Design: FRP doors shall be of seamless press-molded construction.
 - b. Stiles, Rails & Astragals: A high-modulus pultruded FRP square or rectangular tube subframe is to be provided within the door.
 - c. Core: Triangular shaped 3/8 inch cell phenolic resin impregnated kraft paper honeycomb core.
 - d. Internal Reinforcement: High-modulus pultruded tubular FRP, high-density polymer compression blocks, or plastic compression blocking at all hardware and corner locations
 - e. Faces: Door facings shall utilize a chemical resistant thermosetting polyester resin system with fiber reinforcing layers
 - f. Finish: Exposed FRP door faces shall have a 3 to 4 mils (wet) factory applied two-part aliphatic industrial polyurethane fully cured coating.
 - g. Louvers: Fiberglass inverted 'V' blade from pultruded FRP profiles with a minimum fiberglass content of 50 percent.

B. Heavy Duty FRP Door Frames

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tiger Door; Heavy Duty FRP Door or comparable product by one of the following:
 - a. ChemPruf
2. Physical Properties:
 - a. Design: FRP door frames shall utilize a high-modulus pultruded structural FRP shape. Standard double rabbeted 5-3/4 inch deep by 2 inch face by 3/16 inch thick, with integral 5/8 inch doorstop, to match typical hollow
 - b. Corner Joints: Frame jambs and header shall be joined at corners via miter connections with hidden FRP angle clips and fasteners
 - c. Hardware Reinforcement: Chemically welded to door frame
 - d. Anchors:
 - 1) Grout-in: provide manufacturer's required number of wire or strap

type masonry anchors for installation into block wall. Fill frame cavity with grout.

- e. Finish: Exposed FRP door faces shall have a 3 to 4 mils (wet) factory applied two-part aliphatic industrial polyurethane fully cured coating.

C. Mechanical Properties and Test Performance

1. Pultruded structural shapes for stiles, rails, frames and astragals (per ASTM):

- a. Tensile strength (D638): 30,000 psi
- b. Comprehensive strength (D695): 30,000 psi
- c. Flexural strength (D790): 30,000 psi
- d. Flexural modulus (D790): 1,600,000 psi
- e. Shear Strength (D2846): 4,500 psi
- f. Impact, notched (D256): 25 ft-lb/in
- g. Barcol hardness (D2853): 50

2. Core material shall exhibit the following minimum coupon properties (per ASTM):

- a. Shear strength, longitudinal direction (C273) 68.2 psi
- b. Shear strength, transverse direction (C273) 25.8 psi
- c. Shear modulus, longitudinal direction (C273) 6940 psi
- d. Shear modulus, transverse direction (C273) 1878 psi
- e. Shear elongation, longitudinal direction (C393 short beam) 1.79%
- f. Shear elongation, transverse direction (C393 short beam) 2.72%
- g. Maximum facing stress, longitudinal direction (C393 short beam) 735 psi
- h. Maximum facing stress, transverse direction (C393 short beam) 289 psi
- i. Maximum core shear stress, longitudinal direction (C393 short beam) 63.8 psi
- j. Maximum core shear stress, transverse direction (C393 short beam) 24.9 psi
- k. Modulus of elasticity (EI) per 1" width, longitudinal direction (C393 short beam) 4.92E+04 psi
- l. Modulus of elasticity (EI) per 1" width, transverse direction (C393 short beam) 1.97E+04 psi
- m. Maximum facing stress, longitudinal direction (C393 long beam) 9011 psi
- n. Maximum facing stress, transverse direction (C393 long beam) 4727 psi
- o. Maximum core shear stress, longitudinal direction (C393 long beam) 48.3 psi
- p. Maximum core shear stress, transverse direction (C393 long beam) 23.5psi
- q. Modulus of elasticity (EI) per 1" width, longitudinal direction (C393 long beam) 1.14E+05 psi
- r. Modulus of elasticity (EI) per 1" width, transverse direction (C393 long beam) 7.23E+05 psi
- s. Stiffness "D", longitudinal direction (C393 long beam) 379,270 psi
- t. Stiffness "D", longitudinal direction (C393 long beam) 260,608 psi
- u. Compressive strength (C365) 53 psi
- v. Compressive modulus (C365) 2110 psi
- w. Density (C271) 2.42 lb/ft³

3. Adhesive shall exhibit the following minimum coupon properties (per SAE)
 - a. Tensile Strength (D882-83A modified) minimum 2000 psi
 - b. 8 day 25° C at 100% humidity Cross Peel (SAE J1553) minimum 330 psi
 - c. 7 day immersion in seawater Cross Peel (SAE J1553) minimum 330 psi
 - d. 30 day immersion in saltwater Cross Peel (SAE J1553) minimum 330 psi
 - e. 72 hour immersion in gasoline Cross Peel (SAE J1553) minimum 330 psi
 - f. 72 hour immersion in 20% sulfuric acid Cross Peel (SAE J1553) minimum 300 psi
4. CI. ANSI A250.4 1,000,000 cycle test
 - a. 4' x 8' door (up to a full lite) and frame successfully tested in excess of 1,000,000 cycles with no failure of any of the design features of the door or frame.

2.3 FASTENERS

- A. All fasteners for all hardware shall be type 304 CRSS (18-8 series corrosion resistant stainless steel)

2.4 HARDWARE

- A. Doors shall be factory mortised and drilled for mortise template butt hinges, with #12 x 3" long stainless steel screw for hinge attachment. Provide 161 cylindrical lock bore, rim deadbolt, ANSI 86 mortise lock edge prep and pocket, or flushbolt cutouts as required.
- B. Frames shall be factory machined and drilled for all hardware requiring mortises, with #12 x 1-1/4" long stainless steel screws for hinge attachment.
- C. Hardware shall be furnished as listed in section 08 70 00 or as so designated in appropriate section, and shall be coordinated by GC and installed by experienced mechanics.
- D. Supplier shall furnish manufacturer's standard templates, installation instructions, or full size approved door and frame preparation instructions as approved by the architect and as required by door and frame manufacturer prior to door and frame factory initiated manufacture. Standard factory lead-time for production of FRP doors and frames shall commence only and when all distributor required preparation information is received and acknowledged by the door and frame manufacturer.

PART 3 - EXECUTION

3.1 IDENTIFICATION

- A. Factory mark all doors and frames using a chemical resistant plastic tag or indelible marker with identifying number, keyed to shop drawings, prior to shipment.

3.2 INSTALLATION

- A. Frames: Install in strict accordance with manufacturer's printed instructions. Set plumb and square, using shims for bolt-in of existing openings, or wood bracing prior to grouting of jambs. Use at least two 2x6 wood spreaders inside frame to maintain critical opening dimensions during grouting.
- B. Doors: Hang per manufacturer's printed instructions using special screws provided for hinge attachment. Install doors to swing freely and to stand open at any angle. After installation make final adjustments to hardware to allow for proper door operation and latching. All surface applied hardware shall be thru bolted.

3.3 CLEANING

- A. Clean exposed surfaces of FRP doors and frames with a mild, non-abrasive cleaner and water.

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 - Access Control System Units.
 - 4. UL 305 - Panic Hardware.
 - 5. ANSI/UL 437- Key Locks.
- F. Registrations: All hardware specified herein shall be registered with the following agencies, as applicable:

1. California State Fire Marshall.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Proof of Compliance: (California located Projects): Provide a list of product(s) containing chemicals known to cause cancer or reproductive toxicity as defined by the Office of Environmental Health Hazard Assessment (OEHHA) under Proposition 65

(CA Code of Regulations, Title 27, Section 27001). The list includes the specific chemical(s), if the chemical will be exposed to consumers, the means of warning, and an illustration of the label.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

F. California Building Code: Provide hardware that complies with CBC Section 11B.

1. All openings as a part of an accessible route shall comply with CBC Section 11B-404.
2. The clear opening width for a door shall be 32" minimum. For a swinging door 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.
3. Operable hardware on accessible 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 usable from both sides.
4. Hardware (including panic hardware) shall not be provided with "nightlatch" function for any accessible doors or gates unless the following conditions are met:
 - a. Such hardware has a 'dogging' feature and is dogged during the time the facility is open.
 - b. All 'dogging' operation is performed only by employees as their job function (non-public use).
5. The force for pushing or pulling open a door shall be in accordance with CBC Section 11B-404.2.9.
 - a. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 pounds (22.2 N) maximum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed 15 pounds (66.7N). 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.
 - b. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds (22.2N) maximum to comply with CBC Section 11B-309.4.
 - c. The 5 pound (22.2 N) maximum force shall be validated for the size of the door used. The Building Materials Listing of the California State Fire Marshal shall indicate that the door hardware meets the 5 pound (22.2 N) force and shall also list the largest door that can be used.
6. Door closing speed shall comply with CBC Section 11B-404.2.8. Closers 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 minimum. 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.
7. Floor stops shall not be located in the path of travel and 4" maximum from walls.

8. Thresholds shall comply with CBC Section 11B-404.2.5.
 - G. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
 - H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
 - I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
 - J. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.
- 1.6 DELIVERY, STORAGE AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
 - B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:

- a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
- 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
- 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
- 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
- 5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

- 1. Manufacturers:
 - a. Pemko (PE).

2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 2. Furnish dust proof strikes for bottom bolts.
 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 5. Manufacturers:
 - a. Rockwood (RO).
- B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
1. Manufacturers:
 - a. Rockwood (RO).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 3. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 5. Manufacturers:
 - a. Rockwood (RO).

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer's Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

E. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:
 - a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 8800FL Series.

2.6 DEADLOCKS AND LATCHES

A. Cylindrical Deadlocks: ANSI/BHMA A156.36 Grade 1 Certified Products Directory (CPD) listed deadlocks to fit standard ANSI 161 preparation. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:
 - a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - D100 Series.

B. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All

functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8" diameter bolts.

1. Manufacturers:

- a. Adams Rite Manufacturing (AD) - MS1850S / MS1950 Series.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
 1. Manufacturers:
 - a. Norton Rixson (NO) - 8500 Series.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.10 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Norton Rixson (RF).

2.11 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:

1. Pemko (PE).

2.12 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

- B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. YA - ASSA ABLOY ACCENTRA
5. AD - Adams Rite

- 6. RF - Rixson
- 7. NO - Norton
- 8. OT - Other

Hardware Sets

Set: 1.0

Doors: [P100A](#)

Description: Exterior Pair Equip Storage

2 Continuous Hinge	CFM HD1	PE
1 Flush Bolt	2845	US32D RO
1 Dust Proof Strike	570	US26D RO
1 Storeroom or Closet Lock	PB 5405LN	626 YA
2 Mounting Bracket	2601D	Black RO
1 Coordinator	2600 series	Black RO
2 Surface Closer	CPS8501T	689 NO
2 Kick Plate	K1050 10" high CSK BEV	US32D RO
1 Astragal	357SP	PE
1 Gasketing	2891APK	PE
2 Sweep	18062CNB	PE

END OF SECTION

SECTION 093013
CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed wall tile.
2. Waterproof membranes.
3. Crack isolation membranes.
4. Setting material.
5. Grout materials.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.

1.2 DEFINITIONS

- A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For tile, grout, and accessories involving color selection or shade variation from manufacturers full selection of standard and premium colors.
- C. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association.
2. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
3. Installer employs only Ceramic Tile Education Foundation Certified Installers for Project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.8 WARRANTY

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.
 1. Warranty Period: Five years from date of Product Purchase.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Tile: Obtain tile from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Tiling System: Obtain system products from single manufacturer and each aggregate from single source or producer.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Dal-Tile International Corporation; Color Wheel Linear or comparable product by one of the following:
 - a. ARDEX Americas
 - b. Custom Building Products
 - c. Laticrete International, Inc.
 - d. MAPEI Corporation
 2. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
 3. Obtain underlayment from manufacturer of setting and grouting materials.
 4. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
 5. Obtain joint sealants from manufacturer of setting and grouting materials.
- C. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Stone thresholds.
 2. Backer units.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard Grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation on exteriors, do not use back- or edge-

mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 GLAZED WALL TILE

A. Glazed Wall Tile Type:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Dal-Tile International Corporation; Color Wheel Linear, Semi-Gloss or comparable product by one of the following:
 - a. American Olean; a brand of Dal-Tile Corporation
 - b. Crossville, Inc.
 - c. Interceramic
 - d. Jeffrey Court Inc.
 - e. Marazzi USA; a brand of Dal-Tile Corporation
 - f. Vitromex USA, Inc.
2. Module Size: 4 by 8 inches.
3. Face Size Variation: Rectified.
4. Thickness: 5/16 inch.
5. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
6. Grout Color: As selected by Architect from manufacturer's full range.
7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Thinset Mortar Installations: Straight, module size 4 by 8 inches.
 - b. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, module size 4 by 8 inches.
 - c. External Corners for Thinset Mortar Installations: Surface bullnose; same size as adjoining flat tile.
 - d. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

2.4 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer with continuous fabric reinforcement.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MAPEI Corporation
 - b. National Applied Construction Products, Inc.
 - c. Sika Corporation

2.5 CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Crack Isolation Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer with continuous fabric reinforcement.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. H.B. Fuller Construction Products Inc. / TEC
 - b. MAPEI Corporation
 - c. Sika Corporation

2.6 SETTING MATERIALS

- A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products
 - b. H.B. Fuller Construction Products Inc. / TEC
 - c. MAPEI Corporation
 2. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to other requirements in ANSI A118.1.

2.7 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. High-Performance Tile Grout: ANSI A118.7.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ARDEX Americas
- b. Bostik; Arkema
- c. Custom Building Products
- d. H.B. Fuller Construction Products Inc. / TEC
- e. Laticrete International, Inc.
- f. MAPEI Corporation
- g. Parex, a Sika brand
- h. Southern Grouts & Mortars, Inc
- i. Summitville Tiles, Inc.

2. Polymer Type:

- a. Dry, redispersible form, prepackaged with other dry ingredients.
 - b. Liquid-latex form for addition to prepackaged dry-grout mix.
- C. Grout for PregROUTed Tile Sheets: Same product used in factory to pregROUT tile sheets.
- D. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
- E. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.
- F. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without damaging grout or tile.
- G. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- H. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- C. Substrate Flatness:
 1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
 1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.
- B. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- C. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
 1. Add materials, water, and additives in accurate proportions.
 2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

- D. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Exterior tile walls.
 2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
 3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
 4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
 5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
 6. Jointing Pattern: Lay tile in stacked grid pattern as indicated on drawings. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - a. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - b. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
 7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- E. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- F. Grout Sealer: Apply grout sealer to cementitious grout joints in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 FIELD QUALITY CONTROL

A. Water Test:

1. Test of waterproofing membrane in showers and similar areas to be performed by Installation Contractor before setting tile.
 - a. Perform test after 24 hours of waterproof membrane installation.
 - b. Insert test plug in drain or waste line.
 - c. Fill shower base with water, high enough that the membrane-to-drain connection and floor-to-wall transition can be evaluated, and mark wall.
 - d. Check for leaks after 24 hours.
2. Test to be witnessed by Inspector of Record.

B. Nonconforming Work:

1. Waterproof membrane will be considered defective if water level has dropped.
2. Remove and replace defective components and retest.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 EXTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Exterior Wall Installations, Masonry or Concrete:

1. TCNA W202E: Thinset mortar over waterproof membrane.
 - a. Ceramic Tile Type: Color Wheel Linear.
 - b. Thinset Mortar: Dry-set mortar.
 - c. Grout: High-performance sanded cement grout.
 - d. Waterproof Membrane: As recommended by setting material manufacturer.
 - e. Joint Width: 1/8 inch.
 - f. Movement Joints: Types located on Drawings.

END OF SECTION

SECTION 099114
EXTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface preparation of substrates and application of the following:
 - 1. Exterior paint systems.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel substrates.
 - 2. Section 099124 "Interior Painting (MPI Standards)."

1.2 DEFINITIONS

- A. MPI Gloss Level G1: Not more than five units at 60 degrees and 10 units at 85 degrees, in accordance with ASTM D523.
- B. MPI Gloss Level G2: Not more than 10 units at 60 degrees and between 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- C. MPI Gloss Level G3: Between 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- D. MPI Gloss Level G4: Between 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.
- E. MPI Gloss Level G5: Between 35 to 70 units at 60 degrees, in accordance with ASTM D523.
- F. MPI Gloss Level G6: Between 70 to 85 units at 60 degrees, in accordance with ASTM D523.
- G. MPI Gloss Level G7: More than 85 units at 60 degrees, in accordance with ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Include preparation requirements and application instructions.

- 3. Indicate VOC content.
- B. Samples: For each type of topcoat product.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and each color and gloss of topcoat. Submit actual paint drawdowns as specified below for verification Samples.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in applicable exterior painting schedule articles to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each paint product from single source from single manufacturer.

2.2 EXTERIOR PAINTS, GENERAL

- A. Exterior Paint Systems: Subject to compliance with requirements, provide one of the products listed in applicable exterior painting schedule articles for the paint category indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Benjamin Moore & Co.
 - b. California Paints; ICP Building Solutions Group
 - c. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company)
 - d. Sherwin-Williams Company (The)
- B. MPI Standards: Provide products complying with MPI standards indicated in applicable exterior painting schedule articles and listed in the "MPI Approved Products List."
- C. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
 - 3. Flat Paints and Coatings: 50 g/L.
 - 4. Nonflat Paints and Coatings: 50 g/L.
 - 5. Dry-Fog Coatings: 150 g/L.
 - 6. Primers, Sealers, and Undercoaters: 100 g/L.
 - 7. Rust-Preventive Coatings: 100 g/L.
 - 8. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 9. Pretreatment Wash Primers: 420 g/L.
 - 10. Shellacs, Clear: 730 g/L.
 - 11. Shellacs, Pigmented: 550 g/L.
- D. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with

requirements for maximum moisture content and other conditions affecting performance of the Work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Cementitious Composition Board: 12 percent.
 - 3. Masonry (Clay and CMU): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Portland Cement Plaster (Stucco): 12 percent. Verify that plaster is fully cured.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.
 2. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION OF EXTERIOR PAINT PRODUCTS

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in applicable exterior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
 6. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 7. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 8. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - a. Prefinished items include the following factory-finished components:
 - 1) Aluminum storefront and entrances.
 - 2) Anodized aluminum gypsum board and plaster trim.
 - 3) Acoustical wall panels.
 - 4) Toilet and urinal partitions.
 - 5) Stainless steel items.
 - 6) Finished mechanical and electrical equipment.
 - 7) Light fixtures.
 - 8) Distribution cabinets.
 - 9) Finished service panels

- b. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Omit primer on metal surfaces that have been shop primed and touchup painted.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Metal downspouts, rain leaders, conductor heads and supports.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.
 - 3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.

3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility, if available.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE, CONCRETE SUBSTRATES

- A. Horizontal (Traffic) Surfaces:
1. Alkyd Floor Enamel System: MPI EXT 3.2D.
 - a. Prime Coat: Alkyd floor enamel, matching topcoat.
 - b. Intermediate Coat: Alkyd floor enamel, matching topcoat.
 - c. Topcoat: Alkyd floor enamel, low gloss, MPI #59.
 - d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
 2. Water-Based Concrete Floor Sealer System: MPI EXT 3.2H.
 - a. Prime Coat: Sealer, water based, matching topcoat.
 - b. Intermediate Coat: Sealer, water based, matching topcoat.
 - c. Topcoat: Sealer, water based, for concrete floors, MPI #99.
 3. Alkyd Zone/Traffic-Marking Paint System: MPI EXT 3.2F.
 - a. Traffic-marking paint, solvent-based, MPI #32.

3.7 EXTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

- A. Steel and Iron Substrates:
1. Water-Based Light Industrial Coating System: MPI EXT 5.1N.
 - a. Prime Coat: Primer, alkyd, anticorrosive for metal, MPI #79.
 - b. Shop-Applied Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - d. Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level G5), MPI #163.

2. Water-Based Light Industrial Coating over Epoxy System: MPI EXT 5.1R.
 - a. Prime Coat: Primer, epoxy, anticorrosive, MPI #101.
 - b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.
 - c. Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level G5), MPI #163.
 3. Alkyd System: MPI EXT 5.1Q.
 - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Intermediate Coat: Exterior, alkyd paint, matching topcoat.
 - c. Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level G5), MPI #94.
 4. Quick-Dry Enamel System: MPI EXT 5.1A.
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
 - c. Topcoat: Alkyd, quick dry, semigloss (MPI Gloss Level G5), MPI #81.
 5. Aluminum Paint System: MPI EXT 5.1K.
 - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Shop-Applied Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Aluminum paint, matching topcoat.
 - d. Topcoat: Aluminum paint, MPI #1.
- B. Galvanized-Metal Substrates:
1. Latex System: MPI EXT 5.3H.
 - a. Water-Based Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, low sheen (MPI Gloss Levels G3 and G4), MPI #15.
 2. Water-Based Light Industrial Coating System: MPI EXT 5.3K.
 - a. Prime Coat: Primer, galvanized, water based, MPI #134 , andepoxy, anticorrosive, MPI #101.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level G5), MPI #163.
 3. Alkyd System: MPI EXT 5.3N.
 - a. Water-Based Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Exterior, alkyd paint, matching topcoat.
 - c. Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level G5), MPI #94.

4. High-Performance Architectural Latex System: MPI EXT 5.3M.
 - a. Water-Based Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, exterior, high-performance architectural, matching topcoat.
 - c. Topcoat: Latex, exterior, high-performance architectural, low sheen (MPI Gloss Levels G3 and G4), MPI #315.

END OF SECTION

SECTION 099124
INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface preparation of substrates and application of the following:
 - 1. Interior paint systems.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for metal railings for shop priming and painting steel railings.
 - 2. Section 099114 "Exterior Painting (MPI Standards)."

1.2 DEFINITIONS

- A. MPI Gloss Level G1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, in accordance with ASTM D523.
- B. MPI Gloss Level G2: Not more than 10 units at 60 degrees and between 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- C. MPI Gloss Level G3: Between 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- D. MPI Gloss Level G4: Between 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.
- E. MPI Gloss Level G5: Between 35 to 70 units at 60 degrees, in accordance with ASTM D523.
- F. MPI Gloss Level G6: Between 70 to 85 units at 60 degrees, in accordance with ASTM D523.
- G. MPI Gloss Level G7: More than 85 units at 60 degrees, in accordance with ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Include preparation requirements and application instructions.

3. Indicate VOC content.
- B. Samples: For each type of topcoat product.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat. Submit actual paint drawdowns as specified below for verification Samples.
 1. Submit Samples on rigid backing, 8 inches square.
 2. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each paint product from single source from single manufacturer.

2.2 INTERIOR PAINTS, GENERAL

- A. Interior Paint Systems: Subject to compliance with requirements, provide one of the products listed in the applicable interior painting schedule articles for the paint category indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Benjamin Moore & Co.
 - b. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company)
 - c. Sherwin-Williams Company (The)
- B. MPI Standards: Provide products complying with MPI standards indicated in applicable interior painting schedule articles and listed in the "MPI Approved Products List."
- C. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products must be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
 - 3. Flat Paints and Coatings: 50 g/L.
 - 4. Nonflat Paints and Coatings: 50 g/L.
 - 5. Primers, Sealers, and Undercoaters: 100 g/L.
 - 6. Rust-Preventive Coatings: 100 g/L.
 - 7. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 8. Pretreatment Wash Primers: 420 g/L.
 - 9. Floor Coatings: 50 g/L.
 - 10. Shellacs, Clear: 730 g/L.
 - 11. Shellacs, Pigmented: 550 g/L.
 - 12. Low-Emitting Materials: Verify VOC emissions comply with requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Verify formaldehyde emissions do not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 - 13. Verify VOC content does not exceed limits of authorities having jurisdiction and the following:
 - a. Flat Coatings: 50 g/L.
 - b. Nonflat Coatings: 100 g/L.
 - c. Nonflat - High-Gloss Coatings: 150 g/L.
 - d. Concrete/Masonry Sealers: 100 g/L.
 - e. Floor Coatings: 100 g/L.
 - f. Industrial Maintenance Coatings: 250 g/L.
 - g. Low-Solids Coatings: 120 g/L.
 - h. Mastic Texture Coatings: 100 g/L.
 - i. Metallic Pigmented Coatings: 500 g/L.
 - j. Pretreatment Wash Primers: 420 g/L.
 - k. Primers, Sealers, and Undercoaters: 100 g/L.

- l. Reactive Penetrating Sealers: 350 g/L.
- m. Recycled Coatings: 250 g/L.
- n. Rust-Preventive Coatings: 250 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Cementitious Composition Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent. Verify that finishing compound is dry and sanded smooth.
 - 6. Plaster: 12 percent. Verify that plaster is fully cured.
- C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or

apply tie coat as required to produce paint systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 3.
 - 2. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Canvas and Cotton Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- J. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION OF INTERIOR PAINT PRODUCTS

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in applicable interior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
 - 6. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

7. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
8. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - a. Prefinished items include the following factory-finished components:
 - 1) Aluminum storefront and entrances.
 - 2) Anodized aluminum gypsum board and plaster trim.
 - 3) Acoustical wall panels.
 - 4) Toilet and urinal partitions.
 - 5) Stainless steel items.
 - 6) Finished mechanical and electrical equipment.
 - 7) Light fixtures.
 - 8) Distribution cabinets
 - 9) Finished service panels.
 - b. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed to view in equipment rooms:
 - a. Unfinished Equipment, including panelboards.
 - b. Unfinished uninsulated metal piping.
 - c. Pipe hangers and supports.
 - d. Unfinished Metal conduit.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility, if available.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

- A. Steel and Iron Substrates:
 1. Latex System, Alkyd Primer: MPI INT 5.1QQ.
 - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Shop-Applied Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior, semigloss (MPI Gloss Level G5), MPI #54.
 2. Latex over Shop-Applied Quick-Drying Shop Primer System: MPI INT 5.1X.
 - a. Prime Coat: Primer, quick dry, for shop application, MPI #275.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semigloss (MPI Gloss Level G5), MPI #54.
 3. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
 - a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.
- 4. High-Performance Architectural Latex System: MPI INT 5.1RR.
 - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Shop-Applied Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Latex, interior, high-performance architectural, matching topcoat.
 - d. Topcoat: Latex, interior, high-performance architectural, semigloss (MPI Gloss Level G5), MPI #141.
- 5. Water-Based Light Industrial Coating System: MPI INT 5.1B.
 - a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, semigloss (MPI Gloss Level G5), MPI #153.
- 6. Water-Based Light Industrial Coating System over Epoxy Primer System: MPI INT 5.1N.
 - a. Prime Coat: Primer, epoxy, anticorrosive, MPI #101.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, semigloss (MPI Gloss Level G5), MPI #153.
- 7. Alkyd System: MPI INT 5.1EE.
 - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Shop-Applied Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Intermediate Coat: Alkyd, interior, matching topcoat.
 - d. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level G5), MPI #47.
- 8. Alkyd over Surface-Tolerant Primer System: MPI INT 5.1T.
 - a. Prime Coat: Primer, metal, surface tolerant, MPI #23.
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level G5), MPI #47.
- 9. Alkyd over Rust-Inhibitive Primer System: MPI INT 5.1TT.
 - a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level G5), MPI #47.
- 10. Alkyd over Shop-Applied Quick-Drying Shop Primer System: MPI INT 5.1W.

- a. Prime Coat: Primer, quick dry, for shop application, MPI #275.
- b. Intermediate Coat: Alkyd, interior, matching topcoat.
- c. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level G5), MPI #47.

B. Galvanized Metal Substrates:

1. Latex System: MPI INT 5.3J.

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, semigloss (MPI Gloss Level G5), MPI #54.

2. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.

3. Water-Based Light Industrial Coating System: MPI INT 5.3K.

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, semigloss (MPI Gloss Level G5), MPI #153.

4. Alkyd System: MPI INT 5.3L.

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Intermediate Coat: Alkyd, interior, matching topcoat.
- c. Topcoat: Alkyd, interior, semigloss (MPI Gloss Level G5), MPI #47.

END OF SECTION

SECTION 101423
ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.
- B. Related Requirements:
 - 1. Section 101300 "Directories" for building directories.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
 - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - 3. Exposed Accessories: Full-size Sample of each accessory type.
 - 4. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.
- E. Braille Text Certification: Provide certification from the sign manufacturer that Braille text complies with regulatory requirements indicated (Contracted (Grade 2) per CBC Section 11B-703.3).
- F. Braille Text Translation Confirmation: Provide confirmation of Braille text translations.

- G. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with requirements of the following:
 - 1. 2010 ADA Standards for Accessible Design.
 - 2. ANSI A117.1.
 - 3. California Building Code, Sections 11B-216 and 11B-703.
- B. Room or Space Identification Signs, CBC 11B-216.2: Where provided, signs identifying permanent rooms and spaces shall comply with CBC Sections 11B-703.1, 11B-703.2, 11B-703.3, and 11B-703.5. Where pictograms are provided as designations of permanent rooms and spaces, the pictograms shall comply with CBC Section 11B-703.6 and shall have text descriptors complying with CBC Sections 11B-703.2 and 11B-703.5. Exterior signs that are not located at the door to the space they serve shall not be required to comply with CBC Section 11B-703.2.
- C. Directional and Informational Signs, CBC 11B-216.3: Signs that provide direction to or information about spaces and facilities shall comply with CBC Section 11B-703.5.

- D. Means of Egress Signs, CBC 11B-216.4: Tactile exit signs required by CBC Section 1013.4 at doors to exit passageways, exit discharge, and exit stairways shall comply with CBC Sections 11B-703.1, 11B-703.2, 11B-703.3, and 11B-703.5.
- E. Inspection, CBC 11B-703.1.1.2: Signs and identification devices shall be field inspected after installation and approved by the enforcing agency prior to the issuance of a final certificate of occupancy per Chapter 1, Division II, Section 111, or final approval where no certificate of occupancy is issued. The inspection shall include, but not be limited to, verification that Braille dots and cells are properly spaced and the size, proportion and type of raised characters are in compliance with the regulations of CBC Section 11B-703.
- F. Raised Characters, CBC 11B-703.2: Raised characters shall comply with CBC Section 11B-703.2 and shall be duplicated in Braille complying with CBC Section 11B-703.3. Raised characters shall be installed in accordance with CBC 11B-703.4.
1. Depth Raised characters shall be raised 1/32-inch minimum above their background.
 2. Case Raised characters shall be upper case.
 3. Style Raised characters shall be sans serif. Characters shall not be italic, oblique, script, highly decorative, or other unusual forms.
 4. Character Proportions Raised characters (Text) on signs shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase letter "I".
 5. Character Height Character height measured vertically from the baseline of the character shall be of 5/8-inch minimum and 2-inches maximum based on the height of the uppercase letter "I".
 6. Stroke Thickness Stroke thickness of the uppercase letter "I" shall be 15 percent maximum of the height of the character.
 7. Character Spacing Character spacing shall be measured between the two closest points of adjacent raised characters within a message, excluding word spaces. Where characters have rectangular cross sections, spacing between individual raised characters shall be 1/8 inch minimum and 4 times the raised character stroke width maximum. Where characters have other cross sections, spacing between individual raised characters shall be 1/16 inch minimum and 4 times the raised character stroke width maximum at the base of the cross sections, and 1/8 inch minimum and 4 times the raised character stroke width maximum at the top of the cross sections. Characters shall be separated from raised borders and decorative elements 3/8 inch minimum.
 8. Line Spacing Spacing between the baselines of separate lines of raised characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height.
 9. Format Text shall be in a horizontal format.
 10. Finish and Contrast Characters and their background shall have a non-glare finish. Characters shall contrast with their background with either light characters on a dark background or dark characters on a light background. Requirement applies to all signs.
- G. Braille, CBC 11B-703.3 Braille shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4.

- H. Sign Installation Height and Location, per CBC 11B-703.4.
- I. Visual Characters, per CBC 11B-703.5 Visual characters are considered to be intended for signage that is not accompanied by Braille. (The requirements of this Section do not apply to room identification signage.
 - 1. Height from Finish Floor or Ground Visual characters shall be 40 inches minimum above the finish floor or ground measured to the baseline of the character.
 - 2. Stroke Thickness Stroke thickness of the uppercase letter "I" shall be 10 percent minimum and 20 percent maximum of the height of the character.
 - 3. Character Spacing Character spacing shall be measured between the two closest points of adjacent raised characters, excluding word spaces. Spaces between individual characters shall be 10 percent minimum and 35 percent maximum of character height.
 - 4. Line Spacing Spacing between the baselines of separate lines of characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height.
 - 5. Format Text shall be in a horizontal format.
- J. Pictograms, per CBC 11B-703.6.
- K. Symbols of Accessibility, per CBC 11B-703.7.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Best Sign System Inc. or comparable product by one of the following:
 - a. ACE Sign Systems, Inc.
 - b. ASI Sign Systems, Inc
 - 2. Panel Signs
 - a. General: Provide smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally from corner to corner complying with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction
 - b. Design Requirements: Panel signs shall comply with Part 2 Article "Regulatory Requirements for Signs"
 - c. Scheduled Signs: Provide signs as indicated on Drawings and as scheduled in Part 3 Article "Sign Schedule"
 - d. Exterior and Interior Panel Signs: Basis of Design: Best Sign Systems, Inc., HC 300 Series signs complying with the following requirements

- 1) Material: Best Signs Systems Inc., MP Plastic, phenolic-backed melamine plastic laminated faced sheet, .025-inch thick.
 - 2) Edge Condition: Square.
 - 3) Corner Condition: Rounded to 1/2 inch radius.
 - 4) Text Font: Standard Medium.
 - 5) Text Height: Shall comply with "Performance Requirements" within this Section.
 - 6) Mounting: Unframed, wall mounted.
 - 7) Color: As selected by Architect from manufacturer's full range, text and boarder shall contrast with background.
3. Sign Backs/Blanks: Provide matching sign blanks for signs mounted to transparent and/or semi-transparent glazed surfaces to conceal exposed sign backs.
- a. Where sign backs/blanks are located within the interior of the building, signs shall be of the same material as other interior signs.
 - b. Where sign backs/blanks are located on the exterior of the building, signs shall be of the same material as other exterior signs.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - b. Fastener Heads: Use flathead or oval countersunk screws and bolts with tamper-resistant spanner-head slots unless otherwise indicated.
 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard per 11B-703.5.5.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole

for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

- b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 131100
SWIMMING POOL CONTRACTOR GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCE

- A. Requirements in Addenda, Alternates and Conditions collectively apply to this work.

1.2 SUMMARY

- A. Principal Work Items Are:

1. Swimming Pool Contractor Qualifications
2. Swimming Pool Deck Contractor Qualifications
3. Swimming Pool Contractor Responsibilities

- B. Related Work Specified Elsewhere:

1. Section 13 11 05 – Swimming Pool Required Testing and Inspections
2. Section 13 11 09 – Start Up
3. Section 13 11 10 – Swimming Pool Recirculation Equipment
4. Section 13 11 11 – Swimming Pool Piping
5. Section 13 11 15 – Swimming Pool Deck Equipment
6. Section 13 11 16 – Swimming Pool Underwater Lights
7. Section 13 11 20 – Swimming Pool Cast-In-Place Concrete
8. Section 13 11 21 – Swimming Pool Deck Cast-In-Place Concrete
9. Section 13 11 25 – Swimming Pool Cementitious Waterproofing
10. Section 13 11 30 – Swimming Pool Sealants and Caulking
11. Section 13 11 46 – Swimming Pool Trim Tile Finish
12. Section 13 11 61 – Waterslides

1.3 SWIMMING POOL CONTRACTOR'S SUBSTITUTION PROPOSAL

- A. It is the intent of the contract documents to encourage competition. The base proposal must be based on providing the construction methods and equipment as specified and detailed. Substitutions or deviations from the basis of design equipment will not be allowed prior to the bid date.
- B. Contractor shall submit their bid to the Owner based on materials, equipment and methods as specified in this section and sections listed in 131100-1.02.B.
- C. At the discretion of the Owner and Engineer, proposed substitutions may be considered after the Award of Contract. All proposed substitutions of specified construction methods and equipment shall include a complete submittal as required by these specifications and drawings of appropriate scale incorporating and highlighting all required changes. The Contractor shall provide a list of at least ten (10) satisfactory installations comparable to this project that have been manufactured and installed under the manufacturer's current legal name. Submit a list of such projects with the name, address and current telephone number of the Owner's Operator and Architect of Record to the Architect.
- D. Any accepted system substitution must have written approval by the Engineer.

- E. Any changes or modifications to the contract documents that are not authorized by the Owner, Architect or Engineer, shall be the sole responsibility of the Contractor.

1.4 SUBMITTALS

- A. Refer to Division 1 for submittal requirements.

1.5 SWIMMING POOL CONTRACTOR QUALIFICATIONS

- A. It is the intent of the Owner to award this Contract based on the specific experience and financial means required to complete the specified work on the swimming pool system. The successful bidder must be regularly engaged in the construction of commercial pools. Each bidding Contractor shall demonstrate their specific experience and competency by complying with the following requirements.
 - 1. The Swimming Pool Contractor must provide a written statement from an approved bonding company certifying that the Contractor can qualify for 100% Performance and Labor - Material Bonds on this Project.
 - 2. The Swimming Pool Contractor shall provide evidence of having a Contractor's License C53 (California).
 - 3. The Swimming Pool Contractor shall show evidence of having adequate experience in constructing commercial pools. In order to be considered for this Project, the Swimming Pool Contractor must have completed within the last five years at least five (5) public use 25-Yard size pools with a perimeter overflow gutter in conjunction with a self-modulating surge and balance tank system. All these pools shall have been in operation for at least one year. Submit a list of such projects with the name, address, and current telephone number of the Owner and Architect for reference.
 - 4. The Swimming Pool Contractor shall show evidence of having completed three (3) prefabricated stainless steel pools as manufactured by Myrtha.
 - 5. The Swimming Pool Contractor shall show evidence of successfully completing the manufacturer's annual training program referred to as "Pool Academy".
 - 6. The Swimming Pool Contractor shall have completed at least three (3) additional major commercial pool projects (no less than 25-Yards) within the last 5 years. Submit a list of such projects with the name, address, project cost, and current telephone number of the Owner and Architect for reference.

1.6 SWIMMING POOL DECK CONTRACTOR QUALIFICATIONS

- 1. The Swimming Pool Deck Contractor must provide a written statement from an approved bonding company certifying that the Contractor can qualify for 100% Performance and Labor - Material Bonds on this Project.
- 2. The Swimming Pool Deck Contractor shall provide evidence of having a Contractor's License A in the state of the project location.
- 3. The Swimming Pool Deck Contractor shall show evidence of having adequate experience in constructing commercial pools decks. In order to be considered for this Project, the Swimming Pool Deck Contractor must have completed the following projects within the last five years. All these pools shall have been in operation for at least one year. Submit a list of such projects with the name, address, and current telephone number of the Owner and Architect for reference.
 - a. At least five (5) public use swimming pool decks for pools that are 25-Yard size pools or larger.

- b. At least three (3) public use swimming pool decks for pools that include a field-built slot drain.

1.7 SWIMMING POOL CONTRACTOR RESPONSIBILITIES

- A. It is the intent of this section to place the entire responsibility for the construction of each of the pools (including the construction of the pool shell and structures) under one vested Contractor. Under this section the Pool Contractor will provide, but is not limited, to the following:
 - 1. Providing labor, material, management and coordination of own personnel and specialty subcontractors experienced in commercial pool building to produce a functioning Swimming Pool including structure and equipment ready for public use upon completion of the Work. Remove equipment from premises when no longer required.
 - 2. Provide all equipment and services required for erection and delivery onto the premises of any equipment or apparatus furnished. Remove equipment from premises when no longer required.
 - 3. Provide piping installation for all below grade piping. Reference Specification 131111 – Swimming Pool Piping. Coordinate and arrange any required plumbing, health and or building inspections.
 - 4. Complete a Below Grade Hydrostatic Pipe Pressure Test for all systems prior to backfill in accordance with 131105 – Swimming Pool Required Testing and Inspections. Submit results of tests to the Engineer. Maintain pressure throughout the construction process until installation of final fittings.
 - 5. Backfill all piping in accordance with the Geotechnical Engineer of Record and Construction Documents.
 - 6. Provide the main drain hydrostatic relief system and/or a sight sump as shown on the drawings.
 - 7. Provide and install underwater light niche, conduits and pull wire. Route conduits to appropriate junction boxes as shown on the drawings. Secure the light niche to the pool reinforcement prior to shotcrete placement to ensure protection against corrosion.
 - 8. Construct the concrete pool floor and perimeter footings as described in these specifications and detailed on the drawings, including reinforcement steel, inserts, fittings, main drain sumps and all embedded items (piping, anchors, etc.) for the pool. Reference Section 131120 – Swimming Pool Cast-in-Place Concrete.
 - a. Before commencing the placement of concrete, verify electrical bonding of all embedded items and reinforcing steel. Coordinate and arrange any required electrical, plumbing and or building inspections.
 - b. Install waterstops on all penetrations of the pool shell. Provide any structure drainage around the pool as shown on the drawings. Backfill and compact fill around the pool structure, piping trenches and excavations required by this work.
 - 9. Install all manufacturer components including wall panels, structural supports, structural connections and gutter supports, structure and grating. Install and seal PVC membrane per manufacturer requirements.
 - 10. Confirm all electrical conduits that penetrate the pool shell are watertight and installed per N.E.C. Article 680.
 - 11. Provide Swimming Pool sealants and caulking. Reference Section 131130 – Swimming Pool Sealants and Caulking

12. Provide Cementitious Waterproofing for pool main drain sumps, surge tank, and balance tank. Reference Section 131125 – Cementitious Waterproofing.
13. Provide all anchor inserts, gutter grating, and grating support angle and fasteners.
14. Provide and assemble all loose deck equipment. Provide storage for all items and protect. All items are the responsibility of the Contractor until accepted by Owner.
15. Provide and assemble the cleaning and maintenance equipment as specified herein. Provide storage for all items and protect. All items are the responsibility of the Contractor until accepted by Owner.
16. Provide pool filtration system and circulation system, valves, pumps, chemical feed equipment, heaters, water level control system, and all items necessary to operate all systems properly.
17. Provide all electrical conduit, wiring, junction boxes etc. to all low voltage pool equipment within pool filter/chemical rooms. (Low voltage is considered less than 110 V.)
18. Provide the heating system for each pool. Include all piping, heaters, controls, gauges, thermostats, control valves and wiring required to draw water from the recirculation line, heat the water and return it back to the recirculation line and interlock with pool recirculation pumps.
19. Provide all necessary piping and valving as shown on the drawings and specified herein.
20. Provide initial cleaning of the surge tank, balance tank and overflow perimeter skimming system (gutter) of all loose debris and sediment. Contractor may not utilize cleaning equipment to be provided to the Owner.
21. Flush all piping lines and remove any resultant debris and/or sediment.
22. Furnish and install specialty trim tile for gutter tile, waterline tile, depth markers, warning signs, and all other tile installation within the pool structures per Specification 131145 – Swimming Pool Trim Tile.
23. Install underwater lights and pull cords through conduits to their appropriate junction box. Secure underwater light to light niche with stainless steel set screw.
24. Provide Swimming Pool Start-Up as stated in Section 131109 – Swimming Pool Start-Up including minimum consecutive 14-day trouble-free operation. Start, test, calibrate and adjust all mechanical equipment, electrical equipment, recirculation, chemical, and other supplied systems including deck, loose, maintenance, and safety equipment. Instruct the Owner's representative in the systems operation and maintenance as described.
25. Provide initial pool water fill and initial chemical balancing based upon the Ryznar Stability Index and Langelier Saturation Index.
26. Obtain final acceptance by jurisdictional health department(s).
27. USA Swimming Certification
 - a. The Contractor shall provide the services of a registered engineer or land surveyor who shall measure and certify the elevations of the gutter lip at 10 foot centers as well as the length of each lane for each possible racing course. Course length survey must be made with the pool filled with water between 78 and 82 degrees Fahrenheit. Forms for the lane measurements are available from USA Swimming (719-866-3522) and must be submitted to USA Swimming by the Contractor.

1.8 SWIMMING POOL DECK CONTRACTOR RESPONSIBILITIES

- A. It is the intent of this section to place the entire responsibility for the construction of swimming pool deck under one vested Contractor. Under this section the Swimming Pool Deck Contractor will provide, but is not limited, to the following:

SWIMMING POOL CONTRACTOR GENERAL REQUIREMENTS

1. Providing labor, material, management and coordination of own personnel and specialty subcontractors experienced in commercial pool building to produce a functioning Swimming Pool Deck including structure and equipment ready for public use upon completion of the Work. Remove equipment from premises when no longer required.
2. Provide all equipment and services required for erection and delivery onto the premises of any equipment or apparatus furnished. Remove equipment from premises when no longer required.
3. Furnish and install below grade and encased piping systems for pool deck.
4. Layout and install all deck mounted anchors, sockets, and inserts for the pool(s).
5. Prior to concrete pours, verify electrical bonding of the pool embedded items. Coordinate and arrange any required electrical, plumbing and or building inspections to be performed on embedded items.
6. Provide deck finish test panels. Reference Section 131121 – Swimming Pool Deck Cast-in-Place Concrete.
7. Construct the concrete swimming pool deck as described in these specifications and detailed on the drawings, including reinforcement steel, inserts, fittings, slot drain, catch basins, drop outs and all embedded items (piping, anchors, etc.) for the deck. Reference Section 131121 – Swimming Pool Deck Cast-in-Place Concrete.
8. Provide deck finish as described in herein. Deck finish shall match the Owner approved resultant finish from the deck finish test panels.
9. Provide chlorine resistant caulking (sealant), backer rod, and joint fill material at all expansion joints on pool decks. Reference Section 131130 - Swimming Pool Sealants and Caulking.
10. Provide initial cleaning of the Swimming Pool Deck of all loose debris and sediment. All deck drainage systems shall be free of loose debris and sediment. Contractor may not utilize cleaning equipment to be provided to the Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TOLERANCES FOR CONSTRUCTION OF THE POOL SHELL

- A. The completed structures shall be constructed level and to the dimensions, elevation, depths and thickness as shown on the plans.
- B. The elevation tolerance of the pool shell and gutter lip shall be plus or minus 1/8 inch.
- C. The vertical wall surface tolerance of the pool shell, for the first 36 inches from the water surface shall be plus or minus 1/4 inch from plumb measured with a 6 foot straight edge.
- D. For competitive race courses, the following pool shell tolerances shall apply:

Course Tolerance	Minimum	Maximum
25 yard + 1 3/16" / -0"	75' – 3/4"	75' – 1 15/16"
25 meter + 1 3/16" / -0"	82' – 1"	82' – 2 3/16"
50 meter+ 1 3/16" / -0"	164' – 1 1/4"	164' – 2 7/16"
- E. The above dimensions include allowances for a touchpad at each end of the course. The maximum dimension includes the construction tolerance. These above tolerances also apply to courses utilizing moveable bulkhead(s).
- F. The above dimensions apply to a vertical plane extending 1'-0" above and 3'-0" below the surface of the water at all points of both end walls.
- G. Ground wires or grade pins, if used, shall be installed in such a manner that they accurately outline the section of the pool shell as indicated on the plans. They shall be located at intervals sufficient to insure proper thickness throughout and shall be

maintained tight. Grade pins or grounding wires shall not be permanently embedded in the pool shell.

3.2 AS-BUILT DOCUMENTS

- A. Refer to Division 1 for As-Built Documentation requirements.
- B. Swimming Pool Contractor shall provide As-built engineering construction drawings that depict actual as-built conditions of the completed construction as a permanent record of each project feature.
- C. Swimming Pool Contractor shall provide engineering construction drawings depicting actual routing, size and placement of all pool piping, valves, supports.
- D. Swimming Pool Contractor shall provide engineering construction drawings depicting actual routing, sizing and placement of timing system conduits.
- E. General Contractor shall provide engineering construction drawings depicting actual routing, sizing and placement of all pool electrical conduits and note circuitry and conductor routing.
- F. General Contractor shall provide engineering construction drawings depicting actual routing, sizing, and placement of all utilities, including sanitary sewer, storm sewer, fresh water, and natural gas lines.

3.3 CLOSE OUT SUBMITTALS

- A. Refer to Division 1 for Close Out Submittal requirements.

3.4 CONCLUSION

- A. It is the intention of these specifications to provide a complete installation. All accessory construction and apparatus necessary in the operation or testing of the performance of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving the Contractor from furnishing and installing such parts. Any such omission or clarification shall be brought to the attention of the Architect/Engineer prior to bidding as provided in this section.

END OF SECTION

SECTION 131105
SWIMMING POOL REQUIRED TESTING AND INSPECTIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work in this section. Principal work items include:
 - 1. The work under this section shall include all labor, materials, and equipment required to complete the required testing and inspections to be performed by the Swimming Pool Contractor.
 - 2. Required testing and inspections to be performed by the Swimming Pool Contractor shall include:
 - a. Below Grade Hydrostatic Pipe Pressure Test;
- B. Not included in this section is testing and inspections required for construction materials not listed above. Other testing and inspections shall be required as listed in other specification sections.
- C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date or as required in bidding documents.

1.02 SUBMITTALS

- A. All submittals shall be made in accordance with the requirements of Division 1 - General Requirements and in strict compliance with the following procedures and guidelines.
- B. Schedule of Testing and Inspections:
 - 1. Contractor shall provide prior to the start of construction within the general construction schedule when tests and inspections listed in the specification shall be performed.
- C. Product Data:
 - 1. Provide product data for each type of product indicated. Include any technical data and installation requirements.
- D. Test Reports:

1. Submit a sample format for each test report intended for use. Submit test reports required herein only on approved forms.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All products listed are required to perform the testing. All products that are being tested (i.e. concrete, piping, etc.) shall conform with the respective specification section.

2.02 HYDROSTATIC PIPE PRESSURE TEST PRODUCTS

A. Domestic Water

1. Contractor shall utilize the existing domestic fresh water service to fill pipes. The Owner shall assume costs of the water for the initial tests. In the case where the installation fails the initial test and subsequent tests are required, the Contractor shall assume costs of supplying water for each subsequent test, but may still use the domestic fresh water service available.

B. Pressure Gauge

1. Gauges shall be bourdon tube type with a minimum 2-inch diameter dial. Gauge case shall be made of high impact polypropylene, ABS, or stainless steel with an acrylic gauge lens. Socket material shall be brass. Gauge sensor material shall be bronze. Scale shall be white with black divisions and numerals measured in psi with a black enameled balanced Micrometer pointer. Gauge range shall be 0 psi to 100 psi. Accuracy shall be +/-1.5% (3-2-3). Connection shall be either back or lower with 1/4" NPT connection.
2. Basis of Design: Gauges shall be Ashcroft 8008A Commercial Pressure Gauge or approved equal.

C. Pipe Caps / Plugs

1. All pipe caps and plugs shall be of similar material of the adjoining piping that is being capped. Pipe caps and plugs shall be installed in a similar manner to all pipe fittings.

D. Pressure Amplification Pump

1. A pressure amplification pump is only necessary if the domestic water pressure is incapable of providing and sustaining the 1.25 times the pressures required within the specification for the duration required within this specification.
2. The pressure amplification pump shall be capable of providing and sustaining 1.25 times the required pressure for the duration of the test.

3. Basis of Design: Pressure Amplification Pump shall be 115V AC Booster Pump, single phase, maximum 117 psi, 3/8-inch NPT inlet size, manufactured by SHURFLO or approved equal

E. Air Relief Valve

1. Air Relief Valve shall be a brass ASME Safety Relief Valve with stainless steel spring with 1/4" NPT connection.
2. Basis of Design: Air Relief Valves shall be ST25, ST Series Soft Seat Safety Valve by Control Devices, LLC or approved equal.

PART 3 - EXECUTION

3.01 HYDROSTATIC PIPE PRESSURE TEST PROCEDURE

- A. Pipe test procedure is based on AWWA C605-13. For further clarification, refer to AWWA C605-13.
- B. Hydrostatic testing described in this section shall be conducted with water or other environmentally safe, incompressible fluids, because of the inherent safety hazard potential associated with testing components and systems with compressed or other compressed gases.
- C. All pipes shall be capped and sufficiently extend beyond the swimming pool finishes to allow for cutting and installation of any fittings including return inlets, main drain sumps.
- D. Each system of piping shall be tested for its entirety that it is below grade. The return piping shall be tested from within 15 feet of the footprint of the equipment room slab or pump pit to the return inlets within the finish swimming pool surface. The suction piping shall be tested from within 15 feet of the footprint of the equipment room slab or pump pit to the main drain sumps within the finish swimming pool surface. For constructability purposes, if a surge tank is included in the design, the suction lines may be tested from the main drain sumps within the finish swimming pool surface and within the surge tank finish and then again from within the surge tank finish to within 15 feet of the footprint of the equipment room slab or pump pit.
- E. The Contractor shall provide measurement gauges and recording devices for the test, including pump, pipe, connections, and other necessary apparatus and shall conduct the test. Before testing, the Contractor shall place sufficient backfill to prevent pipe movement, typically embedding 1/3 of the pipe.
- F. When the existing domestic water supply is utilized, the domestic water supply shall be protected from backflow contamination.

- G. Pressure gauges shall be provided at the highest elevation possible and the lowest elevation possible, typically at the shallow end return lines and the main drain lines respectively.
- H. Air relief valves shall be installed at all high points within the system to be tested to allow for proper purging of entrapped air. Taps may be installed at all return inlet piping and a single air relief valve can be utilized to remove entrapped air. This is critical not only for the accuracy of the test but for the safety of the workers that may be within the vicinity of the pressurized pipes.
- I. Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of air. The specified test pressure shall be applied utilizing the existing domestic fresh water supply. If the existing domestic fresh water supply is incapable of providing sufficient pressure for the tests, a pressure amplification pump shall be installed to provide and maintain proper pressures for the duration of the tests.
- J. During tests, the system and exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. Visible leaks shall be repaired and the test re-administered in its entirety. Defective elements shall be repaired or removed and replaced and the test repeated until the test requirements have been met.
- K. The duration of the hydrostatic test shall be 1 hour.
- L. The hydrostatic test pressure shall not be less than 80 psi at the highest elevation along the test section but shall not exceed 150 psi at any point. This pressure shall be maintained for the duration of the hydrostatic test.
- M. The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. No installation will be accepted if the quantity of makeup water is greater than the following
 - 1. For pipes less than 8 inches in diameter, make up water shall not exceed ½ gallon per 1,000 linear feet of piping.
 - 2. For pipes 10 inches or greater, make up water shall not exceed ¾ gallon per linear feet of piping.
 - 3. Visible leaks shall be repaired, regardless of the amount of leakage.
- N. Notice of Nonconformance
 - 1. If the installation does not meet the requirements of this standard, the installation shall be made satisfactory by the Contractor at the Contractor's expense.
- O. Affidavit of Compliance

SWIMMING POOL
REQUIRED TESTING AND
INSPECTION

1. The Contractor shall provide a sworn statement that the installation complies with the requirements of this specification.

END OF SECTION

SECTION 131109
SWIMMING POOL START UP

PART 1 - GENERAL

1.01 SUMMARY

A. Principal work items are:

1. Operation and Maintenance Manuals and Closeout Submittals
2. Pool Fill and Chemical Balance
3. Installation & Operation Certification
4. Owner System Training
5. Project Turnover

B. Related work specified elsewhere:

1. Section 131110 – Swimming Pool Recirculation Equipment
2. Section 131111 – Swimming Pool Piping
3. Section 131115 – Swimming Pool Deck Equipment
4. Section 131116 – Swimming Pool Underwater Lights
5. Section 131140 – Swimming Pool Plaster

1.02 COORDINATION AND CLARIFICATION

A. Coordinate with other contractors or subcontractors all work relating to this section.

B. The Contractor must establish with other contractors or subcontractors, having related work in this section, that all work necessary to complete the pool(s) as shown on the drawings and in the specifications is included in the base bid and alternates to the Owner.

C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.03 OPERATION AND MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS

A. Three weeks prior to filling of pool, submit to the Engineer Start-up Chemical Dosing procedure with listed chemicals and quantities.

B. Detailed operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment supplier and/or Contractor shall prepare an operation and maintenance manual for all equipment. Parts lists and operating and maintenance instructions shall be provided.

C. Each operation and maintenance manual shall include the following:

1. Equipment function and calibration, normal operating characteristics, and limiting conditions.
2. Assembly, installation, alignment, adjustment and checking instructions.
3. Operating instructions for start-up, routine and normal operation, regulation and control, shut down and emergency conditions.

4. One (1) copy of all instructional videos.
5. Operating cycles shall be specifically described in outline format and in referenced detail. A wall-mounted color-coded piping flow diagram shall be provided in the pool equipment room. The diagram shall be engraved on laminated plastic with color-coded piping to match color of coding on piping, and including valves identified with number on tags. The minimum size shall be 11 inch x 17 inch.
6. Include manufacturer recommended maintenance schedule, parts lists, piping diagram (to agree with wall mounted diagram) and trouble-shooting information for all pool mechanical equipment.
7. Using reference to keyed valves and wall diagram, include specific written instructions for procedures to be followed for the following:
 - a. Emptying and refilling the pool(s) including de-watering during the period that the pool(s) will be empty;
 - b. Water level control adjustment and chemical control operation;
 - c. Normal surge tank operation and balancing;
 - d. Filter operation and backwashing; and
 - e. Super chlorination.
8. Lubrication and maintenance instructions.
9. Guide to "trouble-shooting".
10. Parts list and predicted life of parts subject to wear.
11. Outline, cross section, and assembly drawings; engineering data and wiring diagrams.
12. Test data and performance curves, where applicable.
13. Specific written instructions for procedure for emptying and refilling the pool(s) including de-watering during any period that the pool will be empty. Include furnishing and installing a yellow warning sign 8-1/2 in. x 11 in., to be mounted in the filter room, that reads:

WARNING
Prior to Emptying Pool
Consult O & M Manuals for Procedures

Include furnishing and installing a yellow warning sign 8-1/2 in. x 11 in., to be mounted in each chemical room, that reads:

Keep all Caps, Plugs and Tops Tight Fitting to Prevent Escape of Fumes.

14. One set of applicable submittals shall be included in each manual.
- D. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by the Contractor.
 - E. Manuals and other data shall be printed on heavy, first quality paper, 8-1/2 in x 11 in size with standard 3-hole punching and inserted in plastic covers. Drawings and diagrams shall be reduced to 8-1/2 in x 11 in or 11 in x 17 in. Where reduction is not practical, larger drawings shall be folded separately and placed in envelopes that are bound into the manuals. Each envelope shall bear suitable identification on the outside.
 - F. Six (6) bound volumes of each manual shall be submitted. All parts lists and information shall be assembled in substantial manuals and permanent, three-ring or three-post

binders. Material shall be assembled and bound in the same order as specified, and each volume shall have a table of contents and suitable index tabs.

- G. Two (2) flash drives, each containing electronic PDF formats of all manuals and other data, shall be submitted. Drives to have an integrated Universal Serial Bus (USB) interface. One shall be Type USB-A. One shall be Type USB-C.
- H. All material shall be marked with project identification. Non-applicable information shall be marked out or deleted.
- I. Shipment of equipment will not be considered complete until all required manuals and data have been received.

1.04 RECORD DRAWINGS

- A. Provide a complete set of record drawings of the entire pool system(s) including all sub-systems. All record drawings shall be prepared in accordance with the requirements of Division 1 for As-Built Documentation and shall be a complete, stand-alone set. The Contractor shall be permitted to obtain original documents and copy them for this purpose only. Provide the record set on compact disk (AutoCAD Release 2022 or compatible software).

1.05 POOL FILL WATER QUALITY

- A. The Owner shall bear the cost of the water required for one 1 complete filling of each body of water. Removal of iron or copper (if in excess of .3 ppm) will be required for the final fill to avoid staining of the pool finish. Any subsequent fillings or partial fillings (more than 25%) of the pool shall be by the Contractor, at their own expense.
- B. The Contractor shall provide the necessary plant equipment so that the temperature of fill water will be within plus or minus 10 degrees of the ambient air and/or the pool structure at the time of filling. Extreme caution is urged if the temperature variance is greater than 10 degrees F.
- C. The Contractor shall provide the necessary chemicals and to adjust and balance the water chemistry in the pools to the following levels:

PARAMETER	ACCEPTABLE RANGE
pH	7.2 – 7.4
Calcium Hardness	200 – 400 PPM
Total Alkalinity (Calcium Hypochlorite)	60 – 80 PPM
Total Alkalinity (Sodium Hypochlorite)	80 – 120 PPM
Langelier Saturation Index	-0.3 - +0.3
Total Dissolved Solids (TDS)	not to exceed 1,500 PPM

1.06 START-UP CHEMICALS

- A. The Contractor shall maintain the chemical balance of the pool water (including the cost of all chemicals required) until the project, pool and mechanical system(s) are fully operational and accepted by the Architect and the Owner.
- B. The Contractor may utilize the chemical storage and delivery systems during initial chemical balancing where appropriate.
- C. The Contractor shall confirm all chemicals necessary for initial pool balance are on site 3 days prior to the start of plaster application.
- D. Provide the Owner with sufficient quantities of the necessary chemicals to maintain the pool operation for minimum of thirty (30) days from substantial completion or the Owner begins using the pool.
- E. Chemicals to be provided to the Owner shall include those required by the chemical feed systems installed.

PART 2 - PRODUCTS (UNUSED)

PART 3 - EXECUTION

3.01 EXISTING CONDITIONS, INSPECTION AND PREPARATION

- A. Carefully examine all of the contract documents for requirements that affect the work of this section. Prior to starting any work, notify the General Contractor of defects requiring correction. Do not start work until conditions are satisfactory.
- B. Verify that all work by others, related to this section, has been completed. This includes all earthwork, concrete work, and mechanical, electrical and plumbing connections.
- C. Protect all materials and work completed by others from damage while completing the work in this section.

3.02 INSTALLATION CERTIFICATION

- A. The Contractor shall obtain certification of manufacturer's approved installation on the following components or systems for each pool:
 - 1. Recirculation Pump
 - 2. Feature Pumps
 - 3. Filtration System
 - 4. Heating System
 - 5. Chemical Delivery and Monitoring/Alarm Systems
 - 6. Accessible Lift(s)
 - 7. Competitive Deck Equipment
 - 8. Diving Platforms, Stands, and Boards
 - 9. Competitive Timing and Scoring Systems
 - 10. USA Swimming Facility Certification
- B. The Contractor shall obtain formal commission and certification from CAL DOSH (OSHA) for the waterslide installation.

3.03 START UP

- A. Provide final cleaning of the surge tank, overflow perimeter skimming system (gutter) and swimming pool of all loose debris and sediment. Contractor may not utilize cleaning equipment to be provided to the Owner.
- B. Provide Swimming Pool and related equipment Start-Up. Start, test, calibrate and adjust all mechanical equipment, electrical equipment, recirculation, chemical, and other supplied systems.
- C. Provide proof of minimum consecutive 14-day trouble-free operation of each pool system. Lack of chemicals or other non-critical items shall not require a re-start of the trouble-free period but may result in a pause of the trouble-free period.
- D. Provide final cleaning of the surge tank, balance tank, overflow perimeter skimming system (gutter) and swimming pools of all loose debris and sediment. Contractor may not utilize cleaning equipment to be provided to the Owner.
- E. Provide certification that the entirety of pool systems are operational and function correctly through all phases of operation.

3.04 SYSTEM TRAINING

- A. A qualified representative of the Contractor performing work under this section shall put the equipment into operation and instruct the Owner's representatives in the operation of this equipment to the Owner's satisfaction immediately after project's substantial completion.
- B. The Contractor's training representative shall have completed the equipment/system's manufacturer's training requirements and be certified, by the manufacturer, to provide and teach system training.
- C. The representative from the Contractor shall be either a CPO (Certified Pool Operator) or have an AFO (Aquatic Facility Operator) certification.
- D. Training periods shall consist of 8 hours of on-site training and scheduled as follows:
 - 1. 4 hours of initial training on the complete swimming pool system. The 4 hours of initial training is to be comprised of at least 1 hour of training on water chemistry analysis and adjustment. The water chemistry training will include in depth review of the use of the Langelier Index and its computation.
 - 2. The initial 4 hours of training shall include information on the care, operation, adjustment, and maintenance of all items provided by the Contractor under the "Part 2 – Products" section of specification 131110 and related specifications
 - 3. 4 hours of training after the Owner's staff has had experience operating the system. This time may be requested any time after the pool has been placed in operation within a period of one (1) year from the time the pool was accepted by the Owner. The additional training shall contain at least 1 hour of review of water chemistry.
 - 4. The Contractor shall provide a project specific video recording instruction manual in addition to the training sessions. The video instructions shall be project specific and shall include information on the care, operation, adjustment, and maintenance of all items provided by the Contractor under these specifications. This video recording shall be done separate from the Owner training.

5. The Contractor shall include one (1) copy of all video recording instructions in each Operations and Maintenance Manual.

3.05 PROJECT TURNOVER

- A. Prior to leaving the job, the Swimming Pool Contractor shall obtain written certification from the designated Owner's representative acknowledging that the instruction period has been completed and all necessary operating information provided. The Swimming Pool Contractor shall, in their contract, include the cost of one (1) additional days (total 4 hours) of instruction and operational check out by the qualified representative of the Swimming Pool Contractor during the first year of operation.
- B. Written reports of each of these visits outlining the pool's operation, competence and performance of the pool's operation personnel, and other pertinent comments shall be submitted to the Owner and Architect/Engineer within one (1) week after each visit.
- C. The Contractor shall provide specific written procedures to be followed for emptying and refilling the pool as mentioned previously in this section. The procedures must be included in the bound volume of operating instructions and references in the front index with a note headed by the words: "CAUTION -- VERY IMPORTANT".

END OF SECTION

SECTION 131111
SWIMMING POOL PIPING SYSTEMS

PART 1 - GENERAL

1.1 COORDINATION AND CLARIFICATION

- A. Coordinate with other contractors or subcontractors all work relating to this section.
- B. The Contractor must establish with other contractors or subcontractors, having related work in this section, that all work necessary to complete the pool(s) as shown on the drawings and in the specifications is included in the base bid and alternates to the Owner.
- C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in manufacturer's original, unopened containers and crates with all labels intact and legible.
- B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.
- C. Handle materials in a manner to prevent damage.
- D. Store all materials on clean raised platforms with weather protective coverings. Provide continuous protection of materials against damage or deterioration.
- E. Remove damaged materials from site.

1.3 WARRANTIES

- A. The Contractor warrants to the Owner and Architect that materials and equipment provided under the contract will be of good quality and new unless otherwise required or permitted by the contract documents, that the work will be free from defects not inherent in the quality required or permitted, and that the work will conform with the requirements of the contract documents. Work not conforming to these requirements, including substitutions not properly approved and authorized will be considered defective. The Contractor's warranty will exclude remedies for damage or defect caused by abuse, improper or insufficient maintenance, improper operations, modifications not executed by the Contractor or improper wear and tear under normal use. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. All warranties shall be for a period of one year from the date of substantial completion or the owner begins using the pool unless otherwise specified.
- B. The Contractor shall agree to repair or replace any defective or non-complying work at no cost to the Owner upon written notification from the Owner within the warranty period. Pro-rated warranties are not acceptable.

C. Submit all warranties covering, but not limited to the following:

1. Defects in material, workmanship, and installation of the pool piping system for a period of three (3) years.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. General

1. Provide all recirculating piping between the pool(s) and the equipment room, fill receptor and all interconnecting piping to and from the chemical feed systems and chemical controller.
2. Provide all necessary pipe supports and support systems required to support all associated piping and valves.
3. Provide all other tubing, conduit, or piping associated with equipment specified herein. Coordinate with other trades.

B. Pipes

1. Pipe routing as shown and detailed on the contract drawings is diagrammatic only and is not intended to show minor details or exact locations of piping systems. Installation is required to be adjusted to accommodate interference and adjustments anticipated and encountered. Pipe sizes on plans refer to nominal inside diameter of the pipe.
2. All PVC swimming pool piping shall be NSF approved and conform to the requirements of ASTM D-1785.
3. All PVC pipes shall be the product of one manufacturer. Approved manufacturers of PVC piping are Eslon, Harvel, and Chemtrol or approved equal.
4. Swimming pool piping above the floor or deck in the equipment room shall be Schedule 80 PVC.
5. Swimming pool piping below the equipment room floor or deck shall be NSF approved, Schedule 80 PVC.
6. All below grade swimming pool piping not located beneath the pool floor shall be backfilled with native granular material free of ice, clay, debris, organic matter, and rocks not larger than 4" across their greatest dimension, and per recommendations indicated in the project geotechnical report.
7. The influent and effluent lines to the heating system shall be schedule 80 CPVC. Connections between metallic piping and/or equipment and PVC shall be flanged.
8. All PVC and CPVC fittings shall be the product of one manufacturer. Molded fittings shall be as manufactured by Asahi, Eslon, Chemtrol, Harvel, Spear, Lasco or acceptable substitute. Fabricated fittings shall be as manufactured by Harrison Machine, Plastinetics, or acceptable substitute.
9. Chemical feed lines from chemical feeders to recirculation piping shall be Schedule 80 PVC piping. Piping shall be hard piped into the recirculation plumbing. All required valves shall be of all PVC construction.
10. All flanged plumbing connection hardware shall be stainless steel.
11. All materials shall be installed by workmen thoroughly skilled in their trades and all work shall present a neat and mechanical appearance when complete. The Contractor, at no additional expense to the Owner, shall replace or correct any work not judged acceptable by the Architect, Owner's testing agency, or their consultants.

12. All support hardware, brackets, fasteners, hangers, etc. installed in the surge tank shall be 316L stainless steel.
13. No installation shall be made that will provide a cross-connection or interconnection between a distributing supply for drinking purposes and the swimming pool, or between the pool and a sanitary or storm water sewer system that will permit a backflow of water into the pool water system.
14. All piping shall be hydrostatically (water) pressure tested for leaks before and after backfilling to guarantee water tightness per specification 131105. Pneumatic (air) pressure test not allowed.
15. The Contractor shall provide 1/4" PVC water stops for this work for watertight penetration of concrete walls. Water stops shall be round and the O.D. shall be sized to 150% of the O.D. of the pipe. The water stops shall be thermo-welded to the pipe from both sides and shall be located at the centerline of the wall being penetrated prior to placing the concrete to assure a watertight seal.
16. Contractor must adhere to all the applicable provisions in Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.
17. All mechanical equipment to be connected into the recirculation piping system shall be done so using flanged or union connections.
18. Provisions shall be made to purge all pipes in the system.
19. Concentric reducers shall be fiberglass by MerMade Filter, Inc., or equivalent reducers of schedule 80 PVC construction.

C. Pipe Hangers and Supports

1. Manufacturer
 - a. Subject to compliance with these specifications, pipe hanger and support systems shall be manufactured by Cooper B-line (basis of design), Inc, TOLCO, and Anvil International or approved equal.

D. Hanger Finish

1. Indoor Finishes
 - a. Hangers shall be zinc plated in accordance with ASTM B633 or shall have an electro-deposited green epoxy finish.
 - b. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR shall have an electro-deposited green epoxy finish.
 - c. Zinc Plated hardware is not acceptable for use in chemical rooms.
2. Outdoor Finishes, Chemical Rooms & Surge Tanks
 - a. Hanger and strut subject to weathered conditions shall be hot dipped galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dipped galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.
 - b. Hangers and strut located in corrosive areas shall be type 316L stainless steel with stainless steel hardware.

E. Valves

1. Valves 3 inches and larger shall be butterfly type valves, with PVC body, 150# SWP with stainless steel shaft, polypropylene disc and replaceable resilient seat

bonded to a rigid shaft and guaranteed for bubble tight shutoff from 27 inch vacuum to 150 PSI. Extended neck 2 inch beyond flanges for any insulated piping shall be provided with handle for manual operation. All valve components shall be suitable for swimming pool chlorinated water service. Butterfly valves shall be Georg Fischer Type 563, Asahi/America Type SP Pool-Pro, Chemtrol Model-B, Simtech VP series, Colonial Valve 411 Series, or approved equal.

2. Valves smaller than 3 inches shall be PVC true union ball valves, full port, three-piece construction, blowout-proof stem, Viton seal with socket end connectors.
3. Check valves shall be a quick closing non-slam type, either self-aligning wafer or flanged type, of corrosion resistant materials suitable for use in a swimming pool environment. Install check valves in accordance with the manufacturer's recommendations. Locate check valves at least 5 pipe diameters from pumps and fittings. Provide check valves as indicated, where two pumps are used in parallel and on water feature or water play equipment systems where water is being pumped significantly above the source pool water level. Check valves shall be either by Technocheck Corp., model 5050, with epoxy coated cast iron body and bronze swing plates on a stainless steel spring; or approved equal, for installation between 150 lb flanges.
4. Modulating float valve in the surge tank(s) shall have PVC body and stainless steel wafer disc. All hardware shall be non-corrodible. The float-operated valves shall be provided horizontally on the main drain lines in the surge tank(s). Valve shall consist of all non-corrosion components including shaft, float arm, pins and floats. Valve shall be suitable for mounting on a 125E class standard PVC flange. The float arm leverage weight and pivot lengths shall be adjustable to obtain desired ratio of surge tank level change to pool gutter overflow level change. Two floats and stabilizer required. Valve shall be Model FV-D XWB (Extra Weight Ball) as manufactured by MerMade Filter, Inc. or approved equal manufactured by EPD.
5. Submerged valves up to 3 inches shall be PVC true union ball valves. Submerged valves over 3 inches shall be PVC bodied, wafer type, butterfly valves with stainless steel handle extensions as required. Valves shall be by approved manufacturers listed above. Submerged valves must be provided with all stainless steel connectors. The stem housing extensions shall be properly supported and braced.
6. All butterfly type valves 8 inches and larger shall be fitted with a water tight gear operator.
7. All valves located 7 feet or greater off the floor shall be fitted with a chain operator.
8. All submerged valves, valves buried below grade, or valves not readily accessible, shall be provided with a stainless steel reach rod and handle.

F. Pipe and valve identification

1. All exposed pool piping shall be equipped with color coded flow directional arrows at thirty (30) inch intervals per local and state swimming pool health code. The Contractor shall verify that all pool piping identification is in accordance with all local and state health regulations.
2. All valves shall be identified with minimum 1-1/2 inch diameter brass tags stamped with minimum 1/2-inch high numbers and attached to valves with #16 brass jack chain (plastic laminate engraved tags with nylon attachment acceptable). Valves shall be described as to their function and referenced in the operating instruction manual and

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS, INSPECTION AND PREPARATION

SWIMMING POOL PIPING SYSTEMS

- A. Carefully examine all of the contract documents for requirements that affect the work of this section. Prior to starting any work, notify the General Contractor of defects requiring correction. Do not start work until conditions are satisfactory.
- B. Verify that all work by others, related to this section, has been completed. This includes all earthwork, concrete work, and mechanical, electrical and plumbing connections.
- C. Protect all materials and work completed by others from damage while completing the work in this section.

3.2 PIPING INSTALLATION

A. General

1. Provide and erect, according to the best practices of the trade, all piping shown on the drawings and required for the complete installation of these systems. The piping shown on the drawings shall be considered as diagrammatic in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be off set, lowered or raised as required or as directed at the site. This does not relieve the Contractor from responsibility for the proper erection of the systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Architect. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods in strict accordance with the manufacturer's instructions. All changes in direction shall be made with fittings. All open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the systems. Plugs of rags, wool, cotton waste or similar materials will not be used in plugging. All piping shall be arranged so as not to interfere with removal and maintenance of equipment, filters or devices, and so as not to block access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided in the piping at connections to all items of equipment. All piping shall be installed to ensure noiseless circulation. All valves and specialties shall be so placed to permit easy operation and access.

B. Pipe Hangers and Supports

1. All piping shall be rigidly supported from the building structure as indicated on the structural drawings.
2. Hanger rods shall be galvanized steel unless otherwise noted on the structural drawings. Provide for controlling level and slope by turn buckles or other approved means of adjustment and incorporate lock nuts.
3. The use of pipe hooks, chains, or perforated iron for pipe hanger supports will not be permitted.
4. Attachment of piping hangers to the building structure shall be provided in a manner approved by the Architect. The Contractor shall provide concrete inserts to be installed by the General Contractor in the building construction at the time the concrete is poured and hangers shall be attached to these inserts.

5. Piping hangers shall be spaced as indicated on the structural drawings and shall have hangers not more than one foot on each side of every change in direction. The piping systems shall be installed in an approved manner and shall not overload the building structural frame. The Contractor shall provide additional hangers and miscellaneous steel supports as required to distribute the piping system load over several structural members where required or directed. Maximum allowable spacing for piping shall be as follows:
6. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non-adhesive isolation tape.
7. Install hangers to provide a minimum of 1-inch space between finished covering and adjacent work.
8. Place a hanger within 12 inches of each horizontal elbow.
9. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
10. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified on the structural drawings. Trapeze hangers shall be spaced according to the smallest pipe size, or install intermediate supports according to the support spacing schedules.
11. Attachment of piping hangers to the building structure shall be provided as indicated on the structural drawings. The Contractor shall provide concrete inserts to be installed by the General Contractor in the building construction at the time the concrete is poured and hangers shall be attached to these inserts.
12. Do not support piping from other pipes, ductwork or other equipment that is not building structure. Do not modify building structure for hanger installation.
13. Piping shall not be supported from the roof deck unless explicitly approved by the structural engineer for a specific condition and attachment method.
14. Hanger rods shall be galvanized steel unless otherwise specified on the structural drawings. Provide for controlling level and slope by turn buckles or other approved means of adjustment and incorporate lock nuts.
15. Where piping is installed side by side, the Contractor will support the piping by utilizing trapeze type hanger assemblies. Horizontal trapeze member shall be non-metallic channel. The Contractor shall provide heavier members as required for the load to be supported for the entire span distance. Hanger rods shall be as specified above and properly sized for the load supported, but not less than 5/8 inches diameter.
16. The use of pipe hooks, chains, or perforated iron for pipe hanger supports will not be permitted.

C. Piping Installation

1. Trench bottoms shall be smooth and free of rocks and debris. If the trench is dug in ledge rock, hardpan or where large boulders are not removed, place 3 inches of sand or compacted fine-grained soil below pipe. Pipe must be supported over its entire length with firm, stable material. Blocking will not be used to change pipe grade or provide intermittent support over low sections in the trench. Surround the pipe with backfill meeting the requirements of Section 312000 with a particle size of 1-1/2 inch or less and in accordance with the project geotechnical report. Compact in layers not to exceed 6 inches with vibratory method. Follow installation methods of ASTM D2774 "Underground Installation of Thermoplastic Pressure Piping".
2. Installations are to be installed in a straight run of pipe, with a minimum 10 pipe diameters upstream and minimum 5 pipe diameters downstream of any pipe fitting.

D. Flushing, Draining and Cleaning Pipe Systems

1. The Contractor shall flush out all water systems with water before placing them in operation. Other systems shall be cleaned by using compressed air or nitrogen. After systems are in operation and during the test period, all strainer screens shall be removed and thoroughly cleaned.

E. Expansion and Contraction

1. The Contractor shall make all necessary provisions for expansion and contraction of piping with offsets, loops, flexible connections and anchors as required to prevent undue strain. The Contractor shall provide shop drawings for proposed method and arrangement for control of expansion and contraction of piping.

F. Swimming Pool Pipe Pressure Testing

1. Contractor is responsible for the maintenance of a sustained 30 PSI pressure on all pool related piping throughout the course of construction.
2. See Section 131105 for Hydrostatic Pipe Pressure Test Procedure.
3. The Contractor shall adhere to the applicable provisions of Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.

END OF SECTION

SECTION 131116
SWIMMING POOL UNDERWATER LIGHTS

PART 1 - GENERAL

1.01 COORDINATION AND CLARIFICATION

- A. Coordinate with other contractors or subcontractors all work relating to this section.
- B. The Contractor must establish with other contractors or subcontractors, having related work in this section, that all work necessary to complete the pool(s) as shown on the drawings and in the specifications is included in the base bid and alternates to the Owner.
- C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.02 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in manufacturer's original, unopened containers and crates with all labels intact and legible.
- B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.
- C. Handle materials in a manner to prevent damage.
- D. Store all materials on clean raised platforms with weather protective coverings. Provide continuous protection of materials against damage or deterioration.
- E. Remove damaged materials from site.

1.03 WARRANTIES

- A. The Contractor warrants to the Owner and Architect that materials and equipment provided under the contract will be of good quality and new unless otherwise required or permitted by the contract documents, that the work will be free from defects not inherent in the quality required or permitted, and that the work will conform with the requirements of the contract documents. Work not conforming to these requirements, including substitutions not properly approved and authorized will be considered defective. The Contractor's warranty will exclude remedies for damage or defect caused by abuse, improper or insufficient maintenance, improper operations, modifications not executed by the Contractor or improper wear and tear under normal use. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. All warranties shall be for a period of one year from the date of substantial completion or the owner begins using the pool unless otherwise specified.

- B. The Contractor shall agree to repair or replace any defective or non-complying work at no cost to the Owner upon written notification from the Owner within the warranty period. Pro-rated warranties are not acceptable.
- C. Submit all warranties covering, but not limited to the following:
 - 1. All underwater lights, niches, conduits, junction boxes, controllers and accessories against defects in material, manufacturer and installation for a period of one (1) year.

PART 2 - PRODUCTS

2.01 UNDERWATER LIGHTS

- A. Underwater lights shall be equivalent to 500 watts of incandescent light. Underwater lights shall be UL listed and in the quantities shown and as detailed in the construction drawings and as described in these specifications. Coordinate for proper installation. Refer to the drawings for quantities and locations.
- B. The pool underwater lights shall be 120VAC, 55 watts LED-type, and equivalent to 500 watts of incandescent light. Fixture housing shall be stainless steel construction with minimum wall thickness of 0.020 inch per UL 676 underwater pool lighting standard. Brass construction pressure grounding lug on interior and exterior services. Lens shall be 8-3/8 diameter clear tempered heat resistant glass. Gasket to be single-piece "U" shaped santoprene or silicone. Fasteners shall be silicon-bronze or stainless steel. Cord entrance shall be a watertight seal and epoxy encapsulated.
- C. The light fixture shall be supplied with a #16-3 STW (120V) or 12-3 SJTW (12V) submersible cord with ground wire positively grounded inside the fixture. Underwater lights shall be provided with cord length as required to reach appropriate utility pedestal.
- D. Underwater lights to be PureWhite LPL-F3W-120 as manufactured by J& J Electronics Inc. or approved equal.

2.02 UNDERWATER LIGHT NICHES

- A. Underwater light niches shall be provided by the swimming pool manufacturer and shall be specifically designed to be integrated into the swimming pool walls.

2.03 JUNCTION BOXES

- A. Junction boxes shall be provided in the quantities required and shall be located at least 8" above the pool coping and 5' from the pool edge. Refer to the Swimming Pool Electrical drawings. Cord length shall be sufficient to run from fixture to the junction box with sufficient cable in the niche to re-lamp the fixture on the deck.
- B. Junction box to be construction of heavy wall cast bronze with silocnoe gaskets and integral grounding lugs. Conduit entry point must be factory tapped.
- C. Junction boxes shall be JB1710 bronze junction box as manufactured by Hydrel, or approved equal.

PART 3 - EXECUTION

3.01 EXISTING CONDITIONS, INSPECTION AND PREPARATION

- A. Carefully examine all of the contract documents for requirements that affect the work of this section. Prior to starting any work, notify the General Contractor of defects requiring correction. Do not start work until conditions are satisfactory.
- B. Verify that all work by others, related to this section, has been completed. This includes all earthwork, concrete work, and mechanical, electrical and plumbing connections.
- C. Protect all materials and work completed by others from damage while completing the work in this section.

3.02 LIGHTING CONTROLS

- A. Main lighting control panel to be installed as shown on the drawings.
- B. Contractor to provide an alternate control switch. Contractor to coordinate location onsite with Owner and Architect.

END OF SECTION

SECTION 131120
SWIMMING POOL CAST-IN-PLACE POOL CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work in this section. Principal items include:

1. The work under this section shall include all labor, materials, and equipment required to complete the concrete work for the following: swimming pool floor(s) and swimming pool wall footings.
2. Materials and/or methods specified in this section as "C.B.C.", "C.B.C. Standards", or similar wording refer to the California Building Code, 2022 Edition.
3. Except as otherwise specified herein, the work of this section shall be in accordance with Chapter 19 "Concrete" of the California Building Code, 2022 Edition.

1.02 SUBMITTALS

A. Product Data: Provide product data for each type of product indicated. Include any technical data and installation requirements.

B. Concrete Mix Design: Provide a mix design for each strength and type of concrete. Furnish a complete list of materials including type, brand, source, and amount of cement, pozzolan, and admixtures. Obtain approval before concrete placement. Any concrete work placed prior to approval of the concrete mix design is not acceptable, is rejected and shall be removed at no cost to the owner.

1. Provide alternate design mixtures when characteristics of materials, project conditions, weather, test results or other circumstances warrant adjustments.
2. Indicate amounts of mixing water to be withheld for later addition at project site in the submittal.

C. Steel Reinforcement Shop Drawings: Provide placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, materials, and grades; bar schedules; stirrup spacing; bent bar diagrams; bar arrangements, splices and laps; mechanical connections; tie spacing; hoop spacing; and supports for concrete reinforcement.

D. Formwork Shop Drawings: Provide formwork shop drawings prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

E. Material Test Reports: Provide reports from a qualified testing agency, indicating compliance with requirements for the following:

1. Aggregates - Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

F. Material Certificates: Provide certificates for each of the following, signed by the manufacturers:

1. Cementitious materials
2. Admixtures
3. Form materials and form-release agents
4. Steel reinforcement and accessories
5. Curing compounds
6. Bonding agents
7. Repair materials

G. Provide field quality control test and inspection reports.

H. Provide minutes of pre-installation conference.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on project personnel qualified as ACI Certified Flatwork Technician and Finisher and a supervisor who is an ACI Certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and complies with ASTM C94 / C94M requirements for production facilities and equipment.

C. Testing Agency Qualifications: An independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated and as documented according to ASTM E548.

1. Personnel conducting field tests shall be qualified as an ICC Certified Reinforced Concrete Technician according to the International Code Council 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.

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

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.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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.
2. 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, forms and form removal limitations, shoring and reshoring procedures, steel reinforcement installation, concrete repair procedures, and concrete protection.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Keep waterstops covered during storage to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Products are subject to compliance with requirements. Products that may be incorporated in the work include, but are not limited to, the products specified.
 2. Available Manufacturers: Manufacturers are subject to compliance with requirements. Manufacturers offering products that may be incorporated in the work include, but are not limited to, the manufactures specified.

2.02 CONCRETE MATERIALS

- A. Cementitious Materials: Use the same type, brand, and source throughout the project. The following cementitious materials are recommended:
 1. Portland Cement: ASTM C150, Standard Specification for Portland Cement.
 2. Fly Ash: ASTM C618, Class C or F.
- B. Normal Weight Aggregate: ASTM C33, Class 5S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 1 in (25 mm) nominal size.
 2. Fine Aggregate: Fine aggregate to be free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C94 / C94M, Clean and potable.

2.03 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494 / C494M, Type A.
 - 2. Retarding Admixture: ASTM C494 / C494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494 / C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494 / C494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494 / C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017 / C1017M, Type II.

2.04 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the 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 mixture designs based on laboratory trial mixtures.
 - 2. Limit use of fly ash to not exceed, in combination, 15% of portland cement by weight.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15% by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.45.

2.05 CONCRETE MIXES

- A. All concrete: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4,500 psi (20.7 MPa) at 28 days
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Minimum Cement Content: 600 lb/yd³
 - 4. Slump Limit:
 - a. 3 in +/- 1 in (75 mm +/- 25 mm) or 8 in (200 mm) for concrete with verified slump of 2 to 4 in (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, +/- 1 in (25 mm).
 - 5. Use Type II/V Cement.
 - 6. Cement to aggregate, in dry weight, shall not be less than one to five.
- B. Shrinkage Tests:

1. Prior to placing any concrete for walls or horizontal surfaces, a trial batch of each mix design of structural concrete shall be prepared using the aggregates, cement and admixture (if any) proposed for the project. From each trial batch at least three (3) specimens for determining drying shrinkage shall be prepared. The drying shrinkage specimens shall be a 4 in x 4 in x 11 in prisms fabricated, cured, dried, and measured in accordance with the requirements of Tentative Method of Test for Length Change of Cement Mortar and Concrete, ASTM C157. The measurements shall be made and reported separately for 7 and 28 days of drying after 7 days of moist curing. The effective gage length of the specimens shall be 10 in, and except for the foundation concrete, the average drying shrinkage at 35 days shall not exceed .055%.
2. Previous Test: Ready-mixed concrete manufacturer may furnish certified test reports from an approved testing laboratory as proof of meeting shrinkage requirements, provided aggregate used and concrete covered by such test report conform to mix design approved for use on this project. Use an independent testing facility for preparing and reporting proposed mix designs. The average drying shrinkage at 35 days shall not exceed .055%.

C. Ready-Mix Concrete

1. Comply with ASTM C94 / C94M.
2. Before using trucks for batching, mixing, and transporting concrete, thoroughly clean the trucks and equipment of materials capable of contaminating concrete.
3. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 is required.
4. When air temperature is between 85 °F and 90 °F, reduce mixing and delivery time from 90 minutes to 75 minutes, and when air temperature is above 90 °F, reduce mixing and delivery time to 60 minutes.
5. Do not add water to ready-mix concrete at project site except when slump is below specified limits and total water does not exceed the design water-cement ratio; inject added water into mixer and mix thoroughly before discharging.

D. Provide certificate signed by authorized official of supplier with each load of concrete stating following:

1. Time truck left plant.
2. Mix of concrete, identify with code number of mix design.
3. Amount of water and cement in mix.
4. Amount and type of admixtures.
5. Amount of water added at project site.
6. Time truck is unloaded at project site.

E. Truck mixers without batch tickets will be rejected.

F. Retain certificates at project site. Submit to the owner/architect for review upon request.

2.06 FORM-FACING MATERIALS

- A. Forming Materials: Forming materials shall be new. Materials may be reused during the progress of the work provided they are completely cleaned and reconditioned, recoated for each reuse, capable of producing formwork of the required quality and are structurally sound.

- B. Smooth-Formed Finished Concrete: Form-facing panels shall be used to provide continuous, true, and smooth concrete surfaces. Furnish panels in the largest practicable sizes to minimize the number of joints.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Medium-density overlay, Class 1 or better, mill-release agent treated and edge sealed.
- C. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 in x 3/4 in (19 mm x 19 mm) minimum
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect the concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 in (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 in (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.07 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615 / A615M, Grade 60 (Grade 420) deformed.
- B. Plain-Steel Wire: ASTM A82, as drawn.

2.08 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports, from steel wire, plastic, or precast concrete, according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- B. Mechanical Splices (Optional): Tapered, threaded couplers, pre-assembled to reinforcing with mounting plate for attachment to form work and a pressed in metal disc thread protector which can be easily removed. The mechanical connection shall

meet building code requirements of developing in tension or compression. The mechanical connection shall be the positive locking, taper threaded type coupler manufactured from high quality steel. The bar ends must be taper threaded using the manufacturer's requirements.

1. Lenton Form Saver; Erico Corp.

2.09 RELATED MATERIALS

- A. Epoxy Bonding Adhesive: ASTM C881, 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, and as follows:
 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 REPAIR MATERIALS

- A. Concrete Patching Mortar: Chemical treatment for waterproofing concrete.
 1. Xypex Concrete Waterproofing by Crystallization, Xypex Chemical Corporation.
 - a. Xypex Concentrate.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before placing new concrete against existing shotcrete/concrete, remove unsound or loose materials and contaminants that may inhibit concrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1 in (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces before placing concrete.
 1. Abrasive blast or hydroblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper concrete bonding.
- B. Earth: Compact and trim to line and grade before placing concrete. Do not place concrete on frozen surfaces. Dampen surfaces before concrete placement. Expansive soils shall be maintained in a moist condition during construction.
- C. Rock: Clean rock surfaces of loose materials, mud, and other foreign matter that might weaken concrete bonding.

3.02 FORMWORK

- A. 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.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 in (3.2 mm) for smooth-formed finished surfaces.
 - 2. Class C, 1/2 in (13 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install recesses, pipe sleeves and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. 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.
- G. 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.
- H. Chamfer exterior corners and edges of permanently exposed concrete. See drawings for other required profiles.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Contract shall not use permanent markers on finished form materials.

3.03 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.

3.04 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of walls, 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 °F (10 °C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70% of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-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 the owner/architect.

3.05 STEEL REINFORCEMENT

- A. General: Fabrication and placement of reinforcing for concrete construction shall be in accordance with the requirements of Title 24, Part 2, California Building Code, and as shown.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.06 JOINTS

- A. Construction Joints in Pool Floor: No construction joints shall be placed in pool floor.
- B. Contraction Joints in Pool Floor: No contraction joints shall be placed in pool floor.
- C. Expansion Joints in Pool Floor: No expansion joints shall be placed in pool floor.

3.07 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water withheld from the concrete mixture at the plant may be added at project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. 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. If a section cannot be placed continuously, provide construction joints as indicated. 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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. 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 in (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or dobies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- 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 low temperature is expected to fall below 40 °F (4.4 °C) 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 or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 °F (32 °C) 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.

3.08 FINISHING FORMED SURFACES

- A. 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 that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-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 defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.09 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen 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.
 1. Apply a trowel finish to surfaces exposed to view or to be covered with ceramic tile, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E1155 / ASTM E1155M, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the work.
 1. All patches shall be watertight.
- B. Contractor shall not use permanent markings on any concrete finishes or finish facing formwork.

3.11 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 ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/ft² x h (1 kg/m² 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.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 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 in (300 mm) 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 in (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply 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.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by methods recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of tile used on project.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland Cement to two and one-half parts fine aggregate passing a No.16 (1.18 mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 in (13 mm) in any dimension in solid concrete, but not less than 1 in (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by owner/architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 in (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Repair defective areas, except random cracks and single holes 1 in (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4 in (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 - 5. Repair random cracks and single holes 1 in (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to engineer's approval, using epoxy adhesive and patching mortar.

- F. Repair materials and installation not specified above may be used, subject to engineer's approval.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
 - 5. 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 C172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one (1) composite sample for each day's pour of each concrete mixture exceeding 5 yd³ (4 m³), but less than 25 yd³ (19 m³), plus one (1) set for each additional 50 yd³ (38 m³) or fraction thereof.
 - a. When frequency of testing will provide fewer than five (5) 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 C143 / C143M; one (1) test at point of placement for each composite sample, but not less than one (1) test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Concrete Temperature: ASTM C1064 / C1064M; one (1) test hourly when air temperature is 40 °F (4.4 °C) and below and when 80 °F (27 °C) and above, and one (1) test for each composite sample.
 - 4. Compression Test Specimens: ASTM C31 / C31M.
 - a. Cast and laboratory cure two (2) sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two (2) sets of two standard cylinder specimens for each composite sample.
 - 5. Compressive-Strength Tests: ASTM C39 / C39M; test one (1) set of two laboratory-cured specimens at 7 days and one (1) set of two specimens at 28 days.
 - a. Test one (1) set of two field-cured specimens at 7 days and one (1) set of two specimens at 28 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.

6. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, the contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 7. 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 (3.4 MPa).
 8. Test results shall be reported in writing to the Owner/Architect, Engineer, 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-day and 28-day tests.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 10. 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 engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 / C42M or by other methods as directed by engineer.
 11. Additional testing and inspecting, at the contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the work that test reports and inspections indicate does not comply with the contract documents.
- D. Measure floor and slab flatness and levelness according to ASTM E1155 / ASTM E1155M within 24 hours of finishing.

END OF SECTION

SECTION 131121
SWIMMING POOL CAST-IN-PLACE DECK CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work in this section. Principal items include:

1. The work under this section shall include all labor, materials, and equipment required to complete the concrete work for the following: pool deck(s), utility pedestal(s), and associated foundations.
2. Materials and/or methods specified in this section as "C.B.C.", "C.B.C. Standards", or similar wording refer to the California Building Code, 2022 Edition.
3. Except as otherwise specified herein, the work of this section shall be in accordance with Chapter 19 "Concrete" of the California Building Code, 2022 Edition.

1.2 SUBMITTALS

- A. Product Data: Provide product data for each type of product indicated. Include any technical data and installation requirements.
- B. Concrete Mix Design: Provide a mix design for each strength and type of concrete. Furnish a complete list of materials including type, brand, source, and amount of cement, pozzolan, and admixtures. Obtain approval before concrete placement. Any concrete work placed prior to approval of the concrete mix design is not acceptable, is rejected and shall be removed at no cost to the owner.
1. Provide alternate design mixtures when characteristics of materials, project conditions, weather, test results or other circumstances warrant adjustments.
 2. Indicate amounts of mixing water to be withheld for later addition at project site.
- C. Steel Reinforcement Shop Drawings: Provide placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, materials, and grades; bar schedules; stirrup spacing; bent bar diagrams; bar arrangements, splices and laps; mechanical connections; tie spacing; hoop spacing; and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Provide formwork shop drawings prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
- E. Material Test Reports: Provide reports from a qualified testing agency, indicating compliance with requirements for the following:

1. Aggregates - Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- F. Material Certificates: Provide certificates for each of the following, signed by the manufacturers:
1. Cementitious materials
 2. Admixtures
 3. Form materials and form-release agents
 4. Steel reinforcement and accessories
 5. Curing compounds
 6. Bonding agents
 7. Repair materials
- G. Provide field quality control test and inspection reports.
- H. Contractor shall provide three (3) 4 FT X 4 FT deck finish test panels with light, medium and heavy broom finishes three weeks prior to placing the finished pool deck concrete. Test panels shall include sample contraction joint.
- I. Contractor shall provide joint spacing plan to Engineer for review 4 weeks prior to first concrete pour.
- J. Provide minutes of pre-installation conference.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on project personnel qualified as ACI Certified Flatwork Technician and Finisher and a supervisor who is an ACI Certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and complies with ASTM C94 / C94M requirements for production facilities and equipment.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated and as documented according to ASTM E548.
1. Personnel conducting field tests shall be qualified as an ICC Certified Reinforced Concrete Technician according to the International Code Council 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.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- 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.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 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.
 - 2. 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, forms and form removal limitations, shoring and reshoring procedures, steel reinforcement installation, concrete repair procedures, and concrete protection.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Keep waterstops covered during storage to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Products are subject to compliance with requirements. Products that may be incorporated in the work include, but are not limited to, the products specified.

2. Available Manufacturers: Manufacturers are subject to compliance with requirements. Manufacturers offering products that may be incorporated in the work include, but are not limited to, the manufactures specified.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials: Use the same type, brand, and source throughout the project. The following cementitious materials are recommended:
 1. Portland Cement: ASTM C150, Standard Specification for Portland Cement.
 2. Fly Ash: ASTM C618, Class C or F.
- B. Normal Weight Aggregate: ASTM C33, Class 5S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 1 in (25 mm) nominal size.
 2. Fine Aggregate: Fine aggregate to be free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C94 / C94M, Clean and potable.

2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C494 / C494M, Type A.
 2. Retarding Admixture: ASTM C494 / C494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C494 / C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494 / C494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494 / C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017 / C1017M, Type II.

2.4 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the 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 mixture designs based on laboratory trial mixtures.

2. Limit use of fly ash to not exceed, in combination, 15% of portland cement by weight.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15% by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.45.

2.5 CONCRETE MIXES

- A. All concrete: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4,500 psi (20.7 MPa) at 28 days
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Minimum Cement Content: 600 lb/yd³
 4. Slump Limit:
 - a. 3 in +/- 1 in (75 mm +/- 25 mm) or 8 in (200 mm) for concrete with verified slump of 2 to 4 in (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, +/- 1 in (25 mm).
 5. Use Type II/V Cement.
 6. Cement to aggregate, in dry weight, shall not be less than one to five.
- B. Shrinkage Tests:
1. Prior to placing any concrete for walls or horizontal surfaces, a trial batch of each mix design of structural concrete shall be prepared using the aggregates, cement and admixture (if any) proposed for the project. From each trial batch at least three (3) specimens for determining drying shrinkage shall be prepared. The drying shrinkage specimens shall be a 4 in x 4 in x 11 in prisms fabricated, cured, dried, and measured in accordance with the requirements of Tentative Method of Test for Length Change of Cement Mortar and Concrete, ASTM C157. The measurements shall be made and reported separately for 7 and 28 days of drying after 7 days of moist curing. The effective gage length of the specimens shall be 10 in, and except for the foundation concrete, the average drying shrinkage at 35 days shall not exceed .055%.
 2. Previous Test: Ready-mixed concrete manufacturer may furnish certified test reports from an approved testing laboratory as proof of meeting shrinkage requirements, provided aggregate used and concrete covered by such test report

conform to mix design approved for use on this project. Use an independent testing facility for preparing and reporting proposed mix designs. The average drying shrinkage at 35 days shall not exceed .055%.

C. Ready-Mix Concrete

1. Comply with ASTM C94 / C94M.
2. Before using trucks for batching, mixing, and transporting concrete, thoroughly clean the trucks and equipment of materials capable of contaminating concrete.
3. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 is required.
4. When air temperature is between 85 °F and 90 °F, reduce mixing and delivery time from 90 minutes to 75 minutes, and when air temperature is above 90 °F, reduce mixing and delivery time to 60 minutes.
5. Do not add water to ready-mix concrete at project site except when slump is below specified limits and total water does not exceed the design water-cement ratio; inject added water into mixer and mix thoroughly before discharging.

D. Provide certificate signed by authorized official of supplier with each load of concrete stating following:

1. Time truck left plant.
2. Mix of concrete, identify with code number of mix design.
3. Amount of water and cement in mix.
4. Amount and type of admixtures.
5. Amount of water added at project site.
6. Time truck is unloaded at project site.

E. Truck mixers without batch tickets will be rejected.

F. Retain certificates at project site. Submit to the owner/architect for review upon request.

2.6 FORM-FACING MATERIALS

- A. Forming Materials: Forming materials shall be new. Materials may be reused during the progress of the work provided they are completely cleaned and reconditioned, recoated for each reuse, capable of producing formwork of the required quality and are structurally sound.
- B. Smooth-Formed Finished Concrete: Form-facing panels shall be used to provide continuous, true, and smooth concrete surfaces. Furnish panels in the largest practicable sizes to minimize the number of joints.

1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Medium-density overlay, Class 1 or better, mill-release agent treated and edge sealed.
- C. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 in x 3/4 in (19 mm x 19 mm) minimum
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect the concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 in (25 mm) to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 in (25 mm) in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.7 STEEL REINFORCEMENT

- A. Reinforcing Bars: **ASTM A615 / A615M, Grade 60 (Grade 420)** deformed.
- B. Plain-Steel Wire: **ASTM A82**, as drawn.

2.8 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports, from steel wire, plastic, or precast concrete, according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- B. Mechanical Splices (Optional): Tapered, threaded couplers, pre-assembled to reinforcing with mounting plate for attachment to form work and a pressed in metal disc thread protector which can be easily removed. The mechanical connection shall meet building code requirements of developing in tension or compression. The mechanical connection shall be the positive locking, taper threaded type coupler

manufactured from high quality steel. The bar ends must be taper threaded using the manufacturer's requirements.

1. Lenton Form Saver; Erico Corp.

2.9 RELATED MATERIALS

A. Epoxy Bonding Adhesive: ASTM C881, 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, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 REPAIR MATERIALS

A. Concrete Patching Mortar: Chemical treatment for waterproofing concrete.

1. Xypex Concrete Waterproofing by Crystallization, Xypex Chemical Corporation.
 - a. Xypex Concentrate.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before placing new concrete against existing shotcrete/concrete, remove unsound or loose materials and contaminants that may inhibit concrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1 in (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces before placing concrete.

1. Abrasive blast or hydroblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper concrete bonding.

B. Earth: Compact and trim to line and grade before placing concrete. Do not place concrete on frozen surfaces. Dampen surfaces before concrete placement. Expansive soils shall be maintained in a moist condition during construction.

C. Rock: Clean rock surfaces of loose materials, mud, and other foreign matter that might weaken concrete bonding.

3.2 FORMWORK

A. 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.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 in (3.2 mm) for smooth-formed finished surfaces.
 - 2. Class C, 1/2 in (13 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install recesses, pipe sleeves and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. 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.
- G. 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.
- H. Chamfer exterior corners and edges of permanently exposed concrete. See drawings for other required profiles.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Contract shall not use permanent markers on finished form materials.

3.3 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.

3.4 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of walls, 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 °F (10 °C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Leave formwork for beam soffits, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70% of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-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 the owner/architect.

3.5 STEEL REINFORCEMENT

- A. General: Fabrication and placement of reinforcing for concrete construction shall be in accordance with the requirements of **Title 24, Part 2, California Building Code**, and as shown.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete. Joints may not intersect any anchors, embeds or other deck features.
- B. Construction Joints: Install construction joints so strength and appearance of concrete is not impaired at locations indicated or as approved by the owner/architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless noted otherwise on drawings. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 in (38 mm) into concrete, unless noted on drawings otherwise.
 - 3. Locate horizontal joints in walls at underside of floors and at the top of floor slabs.

4. Locate vertical joints in walls at corners and in concealed locations where possible.
 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slab-on-Grade (Pool Deck): Contraction joints shall be placed as soon as possible to provide a clean joint with no raveled edges. Contraction joints must be placed within the first 6 hours.
1. Contraction joints shall be placed to produce panels as square as possible. Panels shall not exceed a length to width ratio of 1.5 to 1. Contraction joints shall be spaced between 8 feet and 12 feet.
 2. Contraction joints shall not intercept or traverse any embeds or tile.
 3. Contractor shall provide joint spacing plan to engineer for review 4 weeks prior to first concrete pour.
 4. Contraction joints shall have a minimum depth of one quarter of the thickness of the slab.
 5. Contraction joints may be tooled or sawcut.
- D. Expansion Joints in Slab-on-Grade (Pool Deck): Expansion joints shall be installed in the pool deck where indicated in the project plans. Expansion joints shall be 1/2 in wide and extend through the entire slab.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. 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. If a section cannot be placed continuously, provide construction joints as indicated. 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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. 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 in (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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.

- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or dobies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- 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 low temperature is expected to fall below 40 °F (4.4 °C) 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 or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 °F (32 °C) 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.

3.8 FINISHING FORMED SURFACES

- A. 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 that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.

- B. Smooth-Formed Finish: As-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 defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen 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.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with ceramic tile, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E1155 / ASTM E1155M, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the work.
 - 1. All patches shall be watertight.
- B. Contractor shall not use permanent markings on any concrete finishes or finish facing formwork.

3.11 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 ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/ft² x h (1 kg/m² 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.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 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 in (300 mm) 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 in (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply 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.

- a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by methods recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of tile used on project.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by engineer. Remove and replace concrete that cannot be repaired and patched to engineer's approval
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland Cement to two and one-half parts fine aggregate passing a No.16 (1.18 mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 in (13 mm) in any dimension in solid concrete, but not less than 1 in (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by owner/architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 in (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Repair defective areas, except random cracks and single holes 1 in (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4 in (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

5. Repair random cracks and single holes 1 in (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to engineer's approval.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. 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 C172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one (1) composite sample for each day's pour of each concrete mixture exceeding 5 yd³ (4 m³), but less than 25 yd³ (19 m³), plus one (1) set for each additional 50 yd³ (38 m³) or fraction thereof.
 - a. When frequency of testing will provide fewer than five (5) 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 C143 / C143M; one (1) test at point of placement for each composite sample, but not less than one (1) test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Concrete Temperature: ASTM C1064 / C1064M; one (1) test hourly when air temperature is 40 °F (4.4 °C) and below and when 80 °F (27 °C) and above, and one (1) test for each composite sample.
 4. Compression Test Specimens: ASTM C31 / C31M.

- a. Cast and laboratory cure two (2) sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two (2) sets of two standard cylinder specimens for each composite sample.
 5. Compressive-Strength Tests: ASTM C39 / C39M; test one (1) set of two laboratory-cured specimens at 7 days and one (1) set of two specimens at 28 days.
 - a. Test one (1) set of two field-cured specimens at 7 days and one (1) set of two specimens at 28 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.
 6. When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, the contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 7. 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 (3.4 MPa).
 8. Test results shall be reported in writing to the Owner/Architect, Engineer, 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-day and 28-day tests.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by engineer but will not be used as sole basis for approval or rejection of concrete.
 10. 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 engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 / C42M or by other methods as directed by engineer.
 11. Additional testing and inspecting, at the contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the work that test reports and inspections indicate do not comply with the contract documents.
- D. Measure floor and slab flatness and levelness according to ASTM E1155 / ASTM E1155M within 24 hours of finishing.

END OF SECTION

SECTION 13 1124
SWIMMING POOL MANUFACTURER

PART 1 GENERAL

1.0 DEFINITION

- A. Myrtha Pool: A Myrtha Pool is a custom manufactured product based around the proprietary process of hot calendaring rigid PVC sheets to modular stainless steel self supporting panels.

1.1 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide pool manufacturer's standard and/or custom components and assemblies integrated into a complete system that forms a pool capable of withstanding imposed structural loads, thermally imposed movement, and deterioration from pool chemicals, ultraviolet radiation, weather, site, seismic and service conditions at a minimum as specified in this Article.
- B. Structural Performance: Provide wall panels, structural supports, structural connections capable of withstanding the effects of soil (backfill) pressures, hydrostatic loads and resulting stresses within the limits of the design without leakage and under the specified conditions. Under said stresses the maximum allowable horizontal deflection will be 1/250 of the height of the structure, not to exceed 4mm.
- C. Penetration for wall and floor Systems: Provide wall and floor assemblies manufactured and installed with no water leakages through the system. PVC shall be continuous across connections between wall panels, between wall panels and floor membrane, and across joints between sections of floor membrane.
- D. Sustainable Criteria: Show proof of reduced carbon footprint by a minimum of 30% below conventional construction methodologies; as well as repeatable verification of receiving LEED Certification Gold Level or higher.
- E. Structural Performance: Components shall be structurally independent and capable of withstanding the most extreme seismic conditions prescribed in the current building code; as well as being capable of overcoming limited differential settlement due to deficient soil characteristics.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized experience in erecting and installing work similar in material, design, and extent to that indicated for this project and who is acceptable to manufacturer by having the following characteristics:
 - 1. Has successfully completed five (5) projects similar in type.

2. Has successfully completed the manufacturer's annual training program referred to as "Pool Academy".
 - a. Exception: In lieu of the required number of projects, installer may engage one or more manufacturer-endorsed master installers with a minimum completion of 20 successful projects similar in type.
- B. Manufacturer Qualifications: A firm experienced in manufacturing pools similar to those indicated for this Project and with a record of successful in-service performance.
 1. ISO Registration: Firm shall provide ISO 9001 certificate or provide the following:
 - a. Evidence of successful-audited QA/QC program.
 - b. Test results in accordance with Section 2.04 "TOLERANCES & QUALITY CONTROL"
 - c. Design of all specific components in relation to each other shall be completed in a three dimensional integrated modeling software to ensure to system coordination with the pool and / or building components.
 2. Has successfully manufactured a minimum of 30 projects with a minimum of 50 bodies of water which have been installed within the past 5 (five) years that are similar to the proposed project.
- C. Source Limitations: Obtain all prefabricated pool systems through one source from a single manufacturer.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Deliver components and other manufactured items so as not to be damaged or deformed. Package small components together in crates or containers to prevent loss of small items. Package hazardous and/or sensitive materials together and clearly labeled to indicate use of caution or extra attention is required. Finished panels shall be covered with continuously applied adhesive-fixed protective layer to prevent damage to panel surface. Bundle and secure components to prevent scattering and damage to other materials during shipment.
- B. Storage:
 1. All pool components shall be stored and staged with sufficient site safety and security to ensure damage or losses from vandalism, theft, and weather do not occur. Stack non-structural materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering. Store underlayment and boxed items to ensure dryness. Do not store any plastic components in contact with other

materials that might cause staining, denting, or other surface damage, or in direct sunlight.

2. Store hazardous materials as follows:

- a. Store in a climate controlled environment within temperature ranges specified by product manufacturer.
- b. Keep out of direct sunlight.
- c. Store away from open flame or sources of heat.
- d. Comply with applicable safety regulations governing hazardous material storage and handling.

C. Handling: Unload, store, and erect manufactured pool components to prevent bending, warping, twisting, and surface damage.

1.4 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit according to manufacturer's written instructions and warranty requirements. Various phases of installation may have differing requirements.
- B. Field Measurements: Prior to commencement of installation, site conditions shall be approved in writing by installation contractor as specified in Part 3 "Installation". As projects may be phased, installation contractor shall only approve those portions of the project ready for pool installation.
- C. Concrete Surfaces: Shall be within design tolerances and have at a minimum a broom finish. At all times concrete floor shall be protected from oil, paint, solvents, etc. Installation contractor and manufacturer shall be notified in writing if such items do come in contact with concrete floor. These items shall be remedied as required by manufacturer at Contractor's expense.

1.5 WARRANTY

- A. Special Warranty on Prefabricated Pool System: Written warranty, executed by manufacturer agreeing to repair or replace pool system components provided by manufacturer that have failed and/or directly result in leakage of the pool. The manufacturer and / or their authorized distributors warrant that the provided materials will be free of defects when used and maintained in accordance with Seller's recommendations. Warranty is further limited to include material replacement only and does not cover water, chemicals or labor. Further requirements of the warranty are contained within the Certificate of Guarantee provided by A&T Europe SpA.
1. Warranty Period: Structural integrity and Water-tightness twenty five and ten years from date of Substantial Completion, respectively. Plastic grill structural integrity one year from date of Substantial Completion, (see manufactures warranty).

PART 2 - COMPONENTS

2.0 STRUCTURAL ELEMENTS

- A. Primary components (wall panels and gutters) shall be fabricated by cold working from AISI 441 stainless steel sheet or standard shapes.
1. Wall Panels: Panels fabricated from cold-worked PVC laminated steel (14ga (2mm) steel sheet minimum). Panel construction shall provide for flanged-bolted connections with compatible steel with no through-panel fasteners below tile line. Flange bolt spacing shall not exceed 6" without utilizing flange stiffening element. Wall panels will have a protective plastic film on the interior face (water side) of the panel that will be removed during the installation process, before the pool is filled with water. Wall panels will have a clear, protective coating applied to the exterior face to provide a permanent shield against oxidation from chlorinated atmosphere.
 2. Gutter: Channels fabricated from cold-worked PVC laminated steel (14ga (1.5mm) steel sheet minimum). Gutter construction shall provide for flanged-bolted connections with compatible steel between gutter segments. Gutter splice plates are not permitted. Gutters/gutter supports for tile finished gutters shall be constructed with permanent adjustment system to level gutter at skim line prior to installation of tile (floating of tile on gutter or adjustment of coping over 1/8" to obtain level skim is not permitted). Gutters will have a protective plastic film on the interior face (water side) of the gutter that will be removed during the installation process, before the pool is filled with water. Gutters will have a clear, protective coating applied to the exterior face to provide a permanent shield against oxidation from chlorinated atmosphere.
- B. Secondary components (base frames, panel supports, buttresses, gutter supports, concrete anchors, and miscellaneous hardware) shall be grade AISI 470, A2 or ANSI 316 stainless steel (minimum) and may be fabricated by hot-working as required.
1. Base Frames: 'C'-shaped sections fabricated from cold-worked steel (14ga (2mm) steel sheet minimum). Frame construction shall ensure tight horizontal tolerance and allow for vertical adjustment to compensate for variations in finished concrete.
 2. Panel Supports: Panel supports fabricated from cold-worked steel (14ga (2mm) steel sheet minimum). Flanges, connection plates, and stiffening elements shall be fabricated by cold-working (no steel welding is permitted).
 3. Buttresses: Structural braces fabricated from 14ga (2mm) steel sheet minimum. In lieu of fabrication from cold-worked sheet, buttresses may be fabricated from hot or cold formed standard angle, c, zee or other standard section provided all additional flanges, connection plates, and stiffening elements are fabricated by cold-working (no steel welding is permitted).
 4. Gutter Supports: Brackets fabricated from cold-worked steel (14ga (2mm) steel sheet minimum). Gutter supports shall be fabricated

- integrally with panel supports or separately provided gutter support construction provides for bolted connection to panel supports.
5. Gutter Drain Flanges: Flanges fabricated from hot or cold formed steel. Flanges may be secured to gutter or gutter drain manifold by steel welding. Flanges shall be fabricated to connect to standard PVC flanges. Gutter drains placed in accordance with the architects drawings. No flanges in the gutters is permitted; this would obstruct the free flowing of water into the drain.
 6. Structural Accessories: Anchors, Rods, Bolts, Nuts, and Washers shall be Grade AISI A2 stainless steel minimum.
 7. Raw Steel Components: Hand Rails, Grab Rails, Risers, etc. that are exposed to water directly will be ANSI 316 minimum.
 8. Chemical Anchor capsules shall be in accordance with ASTM E 1512.
- C. PVC-Coated Stainless Steel Plate shall be constructed from PVC coated stainless steel sheet (or blanks) manufactured by hot calendaring PVC to the stainless steel sheet. The bonded PVC shall withstand tensile (de-lamination) force of 27 lbs (120 N) on a sample if 1" at 180° angle de-lamination.
- D. Fabricate elements to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Cold-formed members shall be free of cracks, tears, and ruptures.

2.1 PVC MEMBRANE

- A. Floor Membrane: PVC floor membrane shall be a fiberglass reinforced PVC geomembrane (chemically coated fabric) with the following properties:
1. Minimum thickness of 1.5mm in accordance with ASTM D 374.
 2. Water absorption by ISO 62 methodology #1 < 1% of mass.
 3. Minimum resistance to deformation > 100 lb / inch (900 N / 50 mm).
 4. Yield strength > 285 lb / inch (2,500 N / 50 mm)
 5. Minimum resistance to tearing of > 100 lb (450 N) in accordance with ASTM D 1004.

2.2 ACCESSORIES

- A. Line Anchors: Shall be designed and fabricated to withstand forces specified by floating line manufacturer or by recognized swimming authority. Line anchor construction shall utilize third party bracing elements (not solely supported by wall panel) and/or utilize pool structural system to provide resistance to service forces (line anchors secured only to wall panels are not permitted).
- B. Gutter Mounted Elements: Shall be designed and fabricated to withstand forces specified by accessory manufacturer and/or recognized swimming authority in addition to those service conditions specified by governing code officials. Exposed steel shall be polished stainless steel. All components shall be designed to be flush and there shall be no protrusions of any kind that could potentially produce a tripping hazard

- C. Bottom Drains: Shall be as noted on the plans. Drains shall be equipped with a steel flange, counter flange, two gaskets, compatible fasteners designed to prevent seizing. Drains shall be designed and fabricated to facilitate monolithic concrete slab or block-out type installations and concrete bonding. All sumps shall be in conformance with ANSI/APSP-16 2011.
- D. Grab Rail Anchors: Grab rails penetrating PVC shall be anchored with PVC anchors mounted in concrete. Anchors shall be designed and fabricated to withstand required loads and facilitate simple removal and replacement of the grab rail without damage or part replacement. Grab rail and grab rail anchor sizes shall be coordinate to ensure compatibility.
- E. Gutter Grills: Grills fabricated in multiple-interchangeable segments out of polypropylene. Grills shall be fabricated with buffers or slats parallel to pool edge to limit deck splash-over. Grills shall have an anti-skid surface meeting local code requirements.
- F. Soft-Walk PVC Mesh: PVC mesh [Poly Extruded Matting] is a heat and pressure bonded, non-woven, flexible plastic material with superior tear strength (350psi: ASTM D-624-91), low brittleness in cold weather climates (ASTM D-746-79), significant tensile strength (2190psi: ASTM D-412-92), and contains admixtures to prevent microbial growth.

2.3 TOLERANCES QUALITY CONTROL

- A. Manufacturer shall present certificate of ISO 9001 registration or the following:
 - 1. Manufacturer will employ an independent testing agency chosen by Contractor to perform source quality-control testing and special inspections, and to prepare test reports.
 - a. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
 - b. Manufacturer shall allow testing agency access to places where structural/primary components are being fabricated or produced, and cooperate with testing agency and provide samples of materials as may be requested for additional testing and evaluation.
 - 2. Manufacturer shall correct deficiencies in or remove and replace primary components that inspections and test reports indicate do not comply with requirements.
 - 3. All manufacturing shall be done to millimetric precision with a net result of - 0.000 meters +0.001 meters dimensionally
 - 4. All recirculation components (i.e. – gutter drop-outs, inlets, etc.) shall be designed using static computational fluid dynamics models to ensure appropriate dispersion of chemicals. In addition, the model shall

demonstrate no significant disturbance to the swimmers in the active lanes for competitive pools.

PART 3 - INSTALLATION

3.1 PREPARATION

- A. Site Conditions: Installation contractor shall confirm in writing suitability of project site to proceed with installation.
- 1. Field Measurements: Construction of the pool foundation and floor shall be coordinated and confirmed upon completion. A final survey will be conducted by installation contractor. A drawing and/or report of their findings shall be submitted for review. Deficiencies in any of the areas listed below shall be identified along with other applicable information. The installation contractor along with the manufacturer shall note in writing any possible recommendations for correction of deficient conditions and advise of possible delays and additional costs that may result as soon as possible, specifically considering the following:
 - a. World and relative placement of pool foundation
 - b. Horizontal line
 - c. Elevation
 - d. Concrete finish

3.2 TANK INSTALLATION

- A. Install pool system according to manufacturer's written instructions and installation drawings.
- B. All mud and dirt shall be swept or washed from concrete floor. In addition, oil paint and solvents shall be cleaned and surfaces treated to prevent contact with PVC components.
- C. Install grounding for steel components according to applicable articles and governing codes.
- D. Prior to component installation, all primary components shall be inspected for damage or defect. Do not install damaged or defective components. Notify pool manufacturer immediately of any damaged or defective components.
- E. Do not field cut, drill, or alter primary members without written approval from pool system manufacturer.
- F. Set primary and secondary components in locations and to elevations indicated and according to manufacturer's written specification. Maintain structural stability of pool during installation.
- G. Ensure all basic recommended manufacturer's torque requirements for bolted hardware and connections are followed during manufacturing process.

3.3 WATERPROOFING

- A. General: Install uniform-watertight PVC seals.
 - 1. Wall panel sealing shall be performed according to manufacturer's written instructions.
 - 2. Mechanical (welded PVC) and chemical seals shall be applied within temperature and climatic ranges specified by manufacturer.
- B. Mechanical Seals:
 - 1. Clean surfaces of dirt, dust, debris, and adhesive film by scrubbing with a lightly abrasive fabric or cloth and a mild detergent.
 - 2. Welded components to the panel will be applied in a manner to ensure good bond, free of exposed scorching, and free of substrate blisters and wrinkles.
 - 3. "Hot Welding" shall be performed using manufacturer's approved components and procedures.
- C. Chemical Seals:
 - 1. Clean surfaces of dirt, dust, debris, and adhesive film by scrubbing with a lightly abrasive fabric or cloth and a mild detergent.
 - 2. Avoid application of harsh chemicals and primers on exposed-finished PVC.
 - 3. Apply liquid PVC in thin layers to prevent forming of bubbles in curing PVC. Seal layers shall be free of such bubbles.
 - 4. Install PVC rigid profiles at all panel joints utilizing manufacturer's approved "Cold Welding" techniques.

3.4 PVC MEMBRANE INSTALLATION

- A. Install membrane according to manufacturer's written instructions and installation drawings.
- B. Prior to permanent fixing or welding, PVC membrane shall be inspected for visible defects or blemishes. Do not install damaged or defective membrane. Notify pool manufacturer immediately of any damaged or defective membrane.
- C. PVC membrane shall be stretched both longitudinally and transversely to prevent wrinkles from forming. Wrinkled PVC membrane shall be removed and replaced.
- D. Seams:
 - 1. All seams in membrane and connections between membrane and wall panels shall be heat continuously welded a minimum of 38mm (1½"). Heat welding devices explicitly designed for PVC membrane welding shall be utilized for welding. Welds shall be spot checked per manufacturer's written instruction prior to final seam sealing.

2. PVC weld seams shall not extend into flanged accessory connections. Utilize secondary PVC section to provide uniform surface for flanged connections.
3. Exposed PVC membrane edges shall be sealed with liquid PVC or by heat sealing according to manufacturer's written instructions.

3.5 ACCESSORIES INSTALLATION

- A. General: Install accessories according to accessory manufacturer and pool manufacturer's written instructions and installation drawings and install grounding for steel accessories according to applicable articles and governing codes.

3.6 ERECTION AND LOCATION TOLERANCES

- A. Horizontal Line: Face of pool at pool edge shall remain within +/- 1/8" of designed dimensions.
- B. Structure Elevation: Elevation of wall system below tile or coping shall remain within +/- 1/8" of required elevation to achieve finished pool water level.
- C. Finished Skim Elevation: Finished elevation of skimming tile or coping shall remain within +/- 3/32" of specified pool water level.

END OF SECTION

SECTION 131125
SWIMMING POOL CEMENTITIOUS WATERPROOFING

PART 1 - GENERAL

1.1 Description

A. Work in this section. Principal Items include:

1. Application of polymer modified cement waterproofing.
2. Waterproofing main drain sumps.
3. Waterproofing interior of surge tank
4. Waterproofing interior of balance tank.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 131120 – Swimming Pool Cast-In-Place Concrete
3. Section 131122 – Swimming Pool Shotcrete

1.2 Submittals

A. Comply with requirements of Shop Drawings, Product Data and Samples Section.

B. Product Data: Manufacturer's specifications, data, and installation instructions.

C. LEED Submittals: Comply with requirements for each product to achieve points indicated in LEED Project Checklist provided by the Architect/Engineer.

D. Submit list of project references as documented in this specification under Quality Assurance Article. Include contact name and phone number of the person charged with oversight of each project.

E. Quality Control Submittals:

1. Provide protection plan of surrounding areas and non-work surfaces.

1.3 Quality Assurance:

A. Qualifications:

1. Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products and systems.
2. Manufacturer Qualifications: Company shall be ISO 9001:2015 Certified.
3. Applicator Qualifications: Company with minimum of 5 years' experience in application of specified products and systems on projects of similar size and scope, and is acceptable to product manufacturer.
4. Successful completion of a minimum of 5 projects of similar size and complexity to specified Work.

B. Field Sample:

1. Install field sample at project site or other pre-selected area of building, as directed by Architect/Engineer.
2. Apply material in strict accordance with manufacturer's written application instructions.
3. Manufacturer's representative or designated representative will review technical aspects; surface preparation, application and workmanship.
4. Field sample will be standard for judging workmanship on remainder of project.
5. Maintain field sample during construction for workmanship comparison.
6. Do not alter, move or destroy field sample until work is completed and approved by Architect/Engineer.
7. Obtain Architect/Engineer written approval of field sample before start of material application, including approval of aesthetics, color, texture and appearance.
8. Installer: Trained, certified, and monitored full time for duration of installation by membrane manufacturer.

1.4 Product Delivery and Storage

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Transport and store in unopened containers and keep in clean, dry condition protected from rain, dew and humidity. If dry onsite storage of bags is unavailable or if project is located in a very wet, humid climate, purchase product in manufacturer's packaged metal pails.
- D. Do not stack bags more than two pallets high.
- E. Do not allow MasterEmaco® A660 modifying admixture (formerly Acryl 60) to freeze.

1.5 Job Conditions

- A. Do not apply in rain or when rain is expected within 24 hours. Do not apply above 90 degrees F (32 degrees C) or below 40 degrees F (4 degrees C) or when temperatures are expected to fall below 40 degrees F (4 degrees C) within 24 hours. For hot and cold temperature applications, store materials and water at 50 degrees F (10 degrees C) to 70 degrees F (21 degrees C) before use.

1.6 Warranty

- A. Defects in material, workmanship, and installation of the pool cementitious finish against cracking and delamination for a period of three (3) years.

PART 2 - PRODUCTS

2.1 Materials

- A. Waterproof Coating: MasterSeal 581 (Thoroseal) cement based, aggregate type, heavy duty, waterproof coating for concrete or masonry, as manufactured by Master Builders Solutions, or approved equal. Color shall be grey.

1. Bonding and Modifying Mixture: MasterEmaco A660 (formerly Acryl 60) liquid compound of acrylic polymers and modifiers, as manufactured by Thoro System Products, or approved equal.

B. Water: Clean, fresh, from domestic potable source.

2.2 Proportions and Mixing

- A. Materials are specified on a volume basis and shall be measured in approved containers that will ensure that the specified proportions will be controlled and accurately maintained during progress of the work. Measuring materials with shovels ("shovel count") is NOT permitted.
- B. Mixing: Perform mixing in approved mechanical mixers of the type in which quantity of water can be controlled accurately and uniformly. Mix to manufacturer's recommendations for swimming pool applications. Discard material which has begun to set before it is used; re-tempering is not allowed. Do not use any caked or lumpy materials. Completely empty mixer and mixing boxes after each batch is mixed and keep free of old material.

PART 3 - EXECUTION

3.1 Preparation of Surfaces

A. Surface Conditions Requirements:

1. Existing surfaces to be coated must be smooth and clean. Sandblast existing concrete (old) surface to remove projections, loose particles, foreign matter or construction debris, and make sufficiently rough to provide a strong mechanical bond to 1/16 in amplitude.
2. New concrete to be rough float finish 1/16 in amplitude chip, sandblast, or grind off all defective materials and foreign matter.

B. Surface Repair Requirements:

1. Repair all cracks with "Waterplug" concrete patch, or approved equal.
2. All areas of loose plaster discovered shall be completely removed down to rough concrete.

C. Preparation:

1. Application of waterproofing constitutes acceptance of substrate. Contractor shall be responsible for properly preparing substrate. Any defects from resulting from substrate issues shall be covered under contractor's warranty.
2. Prior to coating, thoroughly wash entire surface with 2,000 psi high-pressure water.
3. Wet cementitious base surfaces with fine fog water spray to produce a uniformly moist condition.
4. Check gutter grates and accessories for correct alignment before coating is started.
5. Do not apply coating to base surfaces containing frost.
6. Install temporary coverings as required to protect adjoining surfaces from staining or damage by waterproofing operations.

3.2 Application of Waterproofing

- A. General: Apply waterproof coating to the manufacturer's minimum thickness at any location. Apply finish coating by manufacturer's approved brushes (do not use a paint brush).
- B. Workmanship:
 - 1. Apply waterproof coating in two coats with second coat applied the next day or before material has become too dry or glazed for good bond.
 - 2. Dampen surface immediately ahead of application.
 - 3. Brush on two coats of waterproof coating, each with a minimum thickness as recommended by the manufacturer.
 - 4. Float final brushed on coat with damp sponge 15 minutes after application to provide a smoother finish without waves, cracks, ridges, pits, projections, or other imperfections.
 - 5. Form coating carefully around curves and angles.
- C. Curing:
 - 1. Cure waterproof coating with fine water mist spray applied to finish coat three or four times at 8-hour intervals or as drying conditions require to prevent premature drying. Do not fill with water for at least 8 days.
- D. Patching and Cleaning up:
 - 1. Upon completion, cut out and patch loose, cracked, damaged, or defective waterproof coating; patches matching existing coating in texture, color, and finish, flush with adjoining coating. Remove waterproof coating droppings or spattering from all surfaces. Leave surfaces in clean unblemished condition ready for pool filling. Remove protective coverings from adjoining surfaces. Remove rubbish and debris from site.

END OF SECTION

SECTION 131130
SWIMMING POOL SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work in this section. Principal Items include:
 - 1. Labor, materials, and equipment to complete sealants and caulking as indicated and specified.

1.02 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Society for Testing Materials (ASTM):
 - a. C920-11 Elastomeric Joint Sealants

1.03 SUBMITTALS

- A. All submittals shall be made in accordance with the requirements of Division 1 - General Requirements and in strict compliance with the following procedures and guidelines.
- B. Certificates of Conformance or Compliance: Submit certificates from the manufacturers attesting that materials meet the specified requirements.
- C. Manufacturers' Descriptive Data: Submit complete descriptive literature for each type of material. Clearly mark data to indicate which type the Contractor intends to provide. Data shall state conformance to specified requirements. Data for sealant and caulking shall include application instructions, shelf life, mixing instructions for multi-component sealants, and recommended cleaning solvents.

1.04 SAMPLE JOINTS

- A. Before Sealant and Caulking Work starts, provide a sample of each type of finished joint where directed. The sample shall show the workmanship, bond, and color of sealant or caulking. The workmanship, bond, and color of work throughout the project shall match that of the approved sample joints.

1.05 ENVIRONMENTAL CONDITIONS

- A. The ambient temperature shall be within the limits of 40 °F and 100 °F when the sealant and caulking are applied, unless noted otherwise herein.

1.06 DELIVERY AND STORAGE

- A. Materials shall be delivered to the job site in the manufacturer's original shipping containers with brand names, date of manufacture, color, and material designation clearly marked thereon.

- B. Containers of elastomeric sealant shall be labeled as to type, class, grade, and use.
- C. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 °F or less than 40 °F.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Products shall conform to the reference documents listed for each use. Color of sealant shall match adjacent surface color unless specified otherwise. For ASTM C920 sealants, use a sealant that has been tested on the types of substrate to which it shall be applied.

2.02 POOL DECK EXPANSION JOINT FILLER

- A. "Deck-O-Foam" expansion joint filler, non-staining closed-cell polyethylene.
- B. #16 silica sand.

2.03 POOL DECK EXPANSION JOINT SEALANT

- A. "Deck-O-Seal" gun grade 2-part joint sealant 2-part polysulfide 2-component chemically cured polysulfide rubber, color as selected by Owner's representative.
 - 1. Approved equal:
 - a. Sika Corporation "Sikaflex 2C SL" 2-component chemically cured urethane sealant, color as selected by Owner's representative.

2.04 POOL DECK EXPANSION JOINT BACKER ROD

- A. Backer rod shall be closed cell, non-absorbent compressible material manufactured for the specific purpose of controlling sealant depth. Manufactured by Sika, Quikrete or approved equal.
- B. Backer rod may be omitted if a backer rod is integrated into expansion joint filler. Backer rod is required if sand is used as expansion joint filler.

PART 3 - EXECUTION

3.01 GENERAL SURFACE PREPARATION

- A. Surfaces shall be clean, dry to the touch, and free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Where adequate grooves have not been provided, clean out grooves to a depth of 1/2 in and grind to a minimum width of 1/4 in without damage to the adjoining Work.

3.02 SEALANT PREPARATION

- A. Do not modify the sealant by addition of liquids, solvents, or powders. Mix multi-component elastomeric sealants in accordance with manufacturer's printed instructions

3.03 GENERAL APPLICATION

- A. Backstops: Where joint cavities are constructed deeper than indicated, tightly pack the back or bottom with backstop material to provide a joint of the depth indicated. Install backstops dry and free of tears or holes.
- B. Primer: Just prior to application of sealant, clean out loose particles from joints. Apply primer in accordance with sealant manufacturer's directions. Do not apply primer to exposed finish surfaces.
- C. Bond Breaker: Provide bond breakers as recommended by the sealant manufacturer for each type of joint and sealant used.
- D. Sealant: Use a sealant that is compatible with the material to and against which it is applied. Do not use a sealant that has exceeded its shelf life or has become too jelled to be discharged in a continuous flow from the gun. Apply sealant in accordance with the manufacturer's printed instructions. Force sealant into joints with sufficient pressure to fill the joints solidly. Sealant shall be uniformly smooth and free of wrinkles.
 - 1. Interior Sealant: Provide sealant at all exposed joints and at all joints indicated to receive sealant.
 - 2. Exterior Sealant: Provide sealant at all joints around the perimeter of openings and at all exposed joints and at all joints indicated to receive sealant.
 - 3. Floor Joint Sealant: Provide sealant in all control joints and in other floor joints indicated or specified.

3.04 POOL DECK EXPANSION JOINT SEALANT

- A. Joint Preparation
 - 1. The number of joints and joint width should be designed for a maximum of $\pm 25\%$ movement. The depth of the sealant should be $1/2$ the width of the joint with a maximum depth of $1/2$ " (12.7 mm) and a minimum of $1/4$ " (6.35 mm).
 - 2. In joints of $1/4$ in to $1/2$ in (6.4 mm to 12.7 mm), the sealant depth at midpoint should be $1/4$ in (6.4 mm). In joints of $1/2$ in to 1 in (12.7 mm to 25.4 mm), the depth at midpoint should be $1/4$ in to $1/2$ in (6.4 mm to 12.7 mm).
 - 3. Control the sealant depth in deep joints with closed-cell backer rod or soft backer-rod. Where the joint depth does not permit the use of backer rod, a bond breaker (polyethylene strip) must be used to prevent three-point bonding.
 - 4. To maintain the recommended sealant depth, install backer rod by compressing and rolling it into the joint channel without stretching it lengthwise. Backer rod should be about $1/8$ in larger in diameter than the width of the joint to allow for compression. Backer rod becomes an integral part of the joint. The sealant does not adhere to it, and no separation bond breaker is required. Do not prime or puncture the backer rod.
- B. Surface Preparation
 - 1. Remove any old joint sealing material by mechanical means. If joint surfaces have absorbed oils, sufficient concrete must be removed to ensure a clean surface.

2. Joint surfaces must be structurally sound, dry, clean, and free of all loose aggregate, laitance, oil, grease, asphalt, paint, wax, mastic compounds, waterproofing compounds, or form release materials.

C. Priming

1. Prime Joint surfaces with manufacturer's recommended primer for the substrate before sealing. If the surfaces are other than shotcrete or concrete, test first to determine adhesion. Seek technical assistance from manufacturer.
2. Apply primer in a thin uniform film. Avoid buildup of film.
3. Allow approximate 30 minutes drying time before applying sealant.
4. Reapply primer if not sealed the same day.
5. To minimize contamination of adjacent surfaces, apply masking tape and remove before sealant has begun to thicken and set.
6. Coverage rate of primers is approximately 35 ft² per pint.

D. Mixing

1. Two two-component systems must be thoroughly mixed before use. The oversize Part-A container allows for the addition and mixing of Part-B and the color pigment.
2. 1-1/3 gallon (5.67 L) unit: (1) Transfer Part-B to Part-A container using a spatula or knife. It is imperative that the entire contents of Part-B be combined with Part-A. (2) With a slow speed drill and a slotted mixing paddle, thoroughly mix for 3 minutes. The paddle blade must be kept below the sealants surface to avoid whipping in air. (3) Transfer the contents of the pigment can into the mixed Part-A and Part-B. Use a spatula or knife, removing the entire contents to ensure consistent color. (4) Continue mixing with a slow speed drill and slotted paddle until color is uniform. During the process, the sides and bottom of the base can and the paddle itself several times.
3. 3 gallon (11.37 L) unit: Use 2 Part-B and 2 pigment container for each Part-A container. Mix as instructed under 1-1/2 gallon (5.69 L) unit.
4. Pot life of the sealant is dependent upon temperature.

E. Application

1. All caulking and sealing should be performed when temperatures are above 40 °F (+4 °C) any moisture or frost on surfaces shall adversely affect adhesion.
2. Ideally, the temperature at the times of application should be the median of temperature extremes when the joint width opening is at its midpoint.
3. Fill joints from the bottom; avoid bridging of the joint that might form air voids.
4. For large joints, the self-leveling grade may be poured directly from the can.
5. For smaller joints and for all slope-grade applications, fill the joint by flowing the sealant from a bulk-loading gun.
6. Light tooling of the sealant is recommended to smooth out ripples. On sloped surfaces, tool from lowest point to highest.

F. Clean Up

1. Immediately after use and before sealant has cured clean equipment with xylene.

G. Curing

1. The cured sealant may be removed by cutting with a sharp-edged tool and thin films by abrading.
2. Protect joint from dirt and traffic overnight. Time for initial cure will vary with humidity and temperature.

3.05 BACKER ROD

A. Installation

1. Closed-cell backer rod must be compressed in the joint at the time of installation. For joint widths up to 3/4 in (19.1 mm), the diameter of the rod should be 1/8 in (3.18 mm) larger than the width of the joint. For 3/4 in (19.1 mm) wide joints use 1 (25.4 mm) diameter rod.
2. Closed-cell backer rod may be easily installed with a blunt probe or a plain-faced roller to force the rod to the desired depth. A template or roller gauge may be used to control the depth at which the rod is placed. Do not puncture, fold, or crease backer-rod. Follow sealant manufacturer's suggestions for joint sealant width and depth ratio.

- B. Backer rod may be omitted if a backer rod is integrated into expansion joint filler. Backer rod is required if sand is used as expansion joint filler.

3.06 PROTECTION

- A. Protection: Protect all areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.
- B. Cleaning: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Upon completion of application, remove all remaining smears and stains resulting there from and leave the Work in a clean and neat condition.

END OF SECTION

SECTION 131145
SWIMMING POOL TRIM TILE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work in this Section: Principal items include:

1. Ceramic tile for swimming pool.

1.2 QUALITY ASSURANCE

A. Reference Standards: Conform to the following standards unless otherwise required herein:

1. American Concrete Institute
 - a. ACI 302 - Guide for Concrete and Floor Slab Construction
2. American National Standards Institute (ANSI):
 - a. A108 - Glazed Wall Tile, Ceramic Mosaic Tile, Quarry Tile and Paver Tile Installed With Portland Cement Mortar.
 - b. A137.1:2012 Standard Specifications for Ceramic Tile.
3. American Society for Testing and Materials (ASTM):
 - a. C150 Portland Cement
 - b. C171-16 Sheet Materials for Curing Concrete
 - c. C206-14 Finishing Hydrated Lime
4. Tile Council of North America (TCNA): Latest Edition, Handbook for Ceramic Tile Installation.

B. Related Sections

1. 131100 – Swimming Pool Contractor General Requirements
2. 131109 - Swimming Pool Start Up
3. 131120 - Swimming Pool Cast-in-Place Pool Concrete
4. 131122 - Swimming Pool Shotcrete
5. 131125 - Swimming Pool Cementitious Waterproofing
6. 131130 – Swimming Pool Sealants and Caulking

1.3 SUBMITTALS

A. All submittals shall be made in accordance with the requirements of Division 1 - General Requirements and in strict compliance with the following procedures and guidelines.

- B. Product Data: Submit the tile manufacturer's printed data identifying each field tile unit and each trimmer and shaped unit by model or type number.
- C. Samples: Submit the following for selection and approval:
 - 1. Each type, shape, and trimmer of tile in each required color.
 - 2. Joint grout colors for each color of tile.
- D. Master Grade Certificates: Submit for each lot of tile before installing

1.4 PRODUCT DELIVERY AND STORAGE

- A. Deliver tile materials to site in unopened factory containers sealed with Grade Seals bearing printed name of manufacturer and the words "Standard Grade". Keep the Grade Seals intact and containers dry until tiles are used. Keep cementitious materials dry until used.

1.5 JOB CONDITIONS

- A. Inspect and verify job conditions. Report all defects in base surfaces to Architect/Engineer for correction before proceeding.
- B. Maintain a temperature range of 40 degrees Fahrenheit to 90 degrees Fahrenheit during installation of tile and grout materials. Tile installation should cure for a minimum 14 days with average an temperature of 70 degrees, while maintaining the minimum 40 degrees and maximum 90 degrees Fahrenheit, prior to filling pool with water.
- C. Vent temporary heaters to outside to avoid carbon dioxide damage to the new tile work.

1.6 WARRANTIES

- A. The Contractor warrants to the Owner that materials and equipment furnished under the contract will be of good quality and new unless otherwise required or permitted by the contract documents, that the work will be free from defects not inherent in the quality required or permitted and that the work will conform to the requirements of the contract documents. Work not conforming to these requirements including substitutions not properly approved and authorized, may be considered defective.
- B. The Contractor's warranty excludes remedy for damage or defect caused by abuse, improper or insufficient maintenance, improper operation, modifications not executed by the Contractor or improper wear and tear under normal usage. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- C. All warranties shall be for a period of five years, unless otherwise specified.
- D. All setting materials shall be provided by the same manufacturer. All mixing materials and application procedures shall be done in accordance with manufacturer's recommendations and requirements. Documentation shall be provided to this effect by the contractor with verification from the manufacturer. This documentation shall be

included in the operations and maintenance manual under warranties as documentation qualifying the project for a 15 Year Systems Warranty by Laticrete International, Inc. or approved equal.

- E. The Contractor shall agree to repair or replace any work at no cost to the Owner upon written notification from the Owner within the warranty period. Pro-rated warranties are not acceptable

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

- A. Portland Cement: ASTM C150, Type II, low alkali
- B. Hydrated Lime: ASTM C207, Type S.
- C. Mortar sand: ASTM C144, at least 4% passing No. 100 sieve.
- D. Joint sand: Same as mortar sand, except all passing the No. 30 sieve.
- E. Water: From domestic potable source
- F. Color pigments: Pure ground mineral oxides, non-fading, alkali and lime proof, factory weighed and packaged.

2.2 TILE MATERIALS

- A. Manufacturer
 - 1. Tile Products: Dal Tile, American Olean, Cepac, Agrob Buchtal or approved equal.
- B. Standard Grade conforming to ANSI A137.1. Additional Tile Requirements include:
 - 1. Provide trim units as indicated and specified, including special shapes as detailed or required.
 - 2. Tile patterns and colors shall be as indicated and specified, colors of approved shades.
 - 3. Mesh mounted or perforated paper backed tile is not allowed where the mesh of paper remains as a permanent part of the installation. If dot mounting is used, a minimum of 67% of the depth of the tile shall be free from any dots to ensure proper grout curing.
 - 4. All 1" x 1" tiles shall be face mounted as guaranteed suitable for pool use by the manufacturer.
 - 5. Use factory-made half-size units where required for tile numbers, or make the half-size units by precision cutting on powered tile saw.
 - 6. Ease all cut tile edges prior to installation.
- C. Glazed Ceramic Tile – See Drawings for location, quantity, and size.
 - 1. Water Line Tile

D. Unglazed Ceramic Mosaic Tile

1. Beach Entry Tile
2. Accessible Ramp Surface Tile
3. Accessible Ramp Edge Trim Tile
4. Accessible Ramp Edge Nosing Trim Tile
5. Stair Entry Tile
6. Stair Nosing Tile
7. Recessed Step Trim Tile
8. Wall Target Tile
9. Lane marking tile
10. Floor Inlet Trim Tile
11. Main Drain Trim Tile
12. Depth Marking Tile
13. "NO DIVING" Warning Tile:

E. Specialty Tile:

1. Handhold tile at pool perimeter.

- F. Trim Units: Provide tile trim units where indicated or necessary for complete and finished installation. Provide bullnose units for external corners and angles. Internal corners shall be squared. External corners shall be mitered. Provide trim units of material and finish identical to adjoining tile, except slip-resistant surfacing is not required for curved or vertical trim units. Provide special type slip-resistant tread nosing units as indicated.

2.3 SETTING BED MORTAR

- A. Manufacturer: LATICRETE International Inc., 3701 Fortified Mortar Bed, thick bed mortar. Polymer fortified blend of carefully selected polymers, Portland cement and graded aggregates. Exceeds ASTM C270 Requirements. Mix and Apply in accordance with Manufacturer's recommendations.

1. Tile Setting Products: LATICRETE International Inc., Mapei Corporation or approved equal.

2.4 BOND COAT

- A. Manufacturer: LATICRETE International Inc., 254 Platinum one step, polymer-fortified thin-set mortar. Exceeds ANSI A118.4 Shear Bond Strength Requirements & ANSI A118.15 (ISO 13007 C2TES1). Mix and apply in accordance with Manufacturer's recommendations as a Bond Coat (placed under setting bed mortar screeds at 'horizontal surfaces').

2.5 THINSET

- A. Manufacturer: LATICRETE International Inc., 254 Platinum one step, polymer-fortified thin-set mortar. Exceeds ANSI A118.4 Shear Bond Strength Requirements & ANSI A118.15 (ISO 13007 C2TES1). Mix and apply in accordance with Manufacturer's recommendations.

2.6 TILE JOINT GROUT

- A. Manufacturer: LATICRETE International Inc., PermaColor Grout. Exceeds ANSI A118.7 (ISO 13007-3 CG2WA) requirements patented high performance grout. Mix and Apply in accordance with Manufacturer's recommendations.

2.7 ELASTOMERIC SEALANT

- A. Manufacturer: LATICRETE International Inc., Latasil sealant over Latasil 9118 primer to seal lighting and plumbing fixture penetrations and for all movement joints. Mix and Apply in accordance with Manufacturer's recommendations.

2.8 MIXING AND APPLICATION PROCEDURES

- A. All mixing and application procedures shall be done in accordance with the manufacturer's recommendations, requirements, and guidelines. A manufacturer's representative shall visit the site to verify field conditions, confirm materials and application requirements, and confirm that all materials and systems are installed per the manufacturer's recommendations, requirements, and guidelines. Documentation shall be provided to this effect for the Design Team's records.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The swimming pool surface shall be structurally sound and free of any foreign substances and debris that could reduce or impair adhesion. Sound and remove all loose concrete to firm substrate. Clean substrates of dust, dirt, oil, grease, and deleterious substances. Conform to applicable Reference Standards and to recommendations of manufacturers of materials used. Thoroughly wash/rinse with clean potable water.
- B. Surface defects or holes in the substrate shall be patched per manufacturer's recommendations.
- C. Substrates To Receive Mortar Setting Beds: Keep cementitious backing damp for at least 8 hours and scrub with a neat Portland cement slurry just prior to placing setting bed mortar.
- D. Tile Wetting: Dampen tile according to above Reference Standards or tile manufacturer's instructions, as required.
- E. Screeds: Accurately set temporary screeds to control the finish plane of mortar-bed set tile and remove as soon as setting bed is sufficiently hardened. Fill void spaces from screeds with same mortar.

3.2 TILE INSTALLATION

- A. Arrange tile according to patterns detailed, set tile flush with well-fitted joints, finish in true planes, that are plumb and square, and with joints of uniform size. Provide approved trimmers as shown or required. Cut tile without marring. Carefully grind and

joint tile edges and cuts. Set tiles to avoid puddles and ponding in large fields and arrange curved field joints at radiuses that minimize joints and tapered grout joints.

- B. Mortar Bed Set Tile: Apply bond coat under dry pack screed mortars at horizontal surfaces (vertical renders / leveling mortars are mixed to a more plastic / plaster like consistency and typically do not require a bond coat). While bond coat remains wet and tacky, apply specified setting bed mortar, tamp, and screed to required planes. Spread no more mortar than can be covered with tile before initial set. Do not use re-tempered mortar. Trowel 1/32" to 1/16" thick bond coat over plastic setting bed mortar just before setting tile or apply bond coat to back of each tile placed. Set tile in position and beat firmly into the setting bed mortar. Bring tile faces to a true and proper plane. Complete all beating and leveling before mortar sets and in no case later than one hour after first placing. When ready, wet and remove paper and glue avoiding excess water. Adjust any out-of-line or out-of-level tile.
- C. Ceramic Tile Joint Grouting:
 - 1. Grout tile joints full after washing out and saturating with clean water. Mix grout with water to a thick creamy consistency and force into joints for entire joint depth, flush with surface. Clean off all excess and fill skips and gaps before grout sets. Use white grout throughout. Provide dampness for minimum 3-day curing and polish with clean dry cloths. Unless otherwise approved, install tile with uniform 3/32 inch joint width. A maximum 1/8" joint width may be utilized to meet specific installation requirements, if required.
- D. Expansion Joints: Install tile with uniform 1/8" joint width. Place expansion joint per applicable TCNA Method P601MB, P601TB, or P602 and conforming to Method EJ171. Provide shop drawings showing backer rod and joint dimensions. All expansion, control, construction, cold, and seismic joints in the pool structure should continue through the tile work, including such joints at vertical surfaces. Movement joints shall be placed at all changes in direction and elevation. Refer to the structural engineer for additional required movement joints. Joint size shall be a minimum of 1/8". Joints through tile work directly over structural joints shall not be narrower than the structural joint. The Contractor shall use cement compatible coatings when using chalk lines for joint layout purposes.

3.3 CLEANING AND PROTECTION

- A. Remove stains, cement, grout, and foreign matter after grouted joints are fully set as recommended by TCNA and manufacturers of proprietary materials. Do not use any acid for cleaning free of both sodium and potassium. Repair all defective joints until approved.
- B. Protect installed tile work with non-staining Kraft paper, polyethylene sheeting, or other approved heavy covering during the construction period to prevent damage.

3.4 TESTING AND INSPECTION

- A. Before filling of the pool, and its subsequent provisional acceptance at substantial completion, the tile installation shall be visually inspected and sounded in the presence of the Architects and/or the Owner's representative to verify adhesion of the tile to its substrate as well as its overall compliance with the requirements of this Section. Any

and all tile work found to be loose, improperly adhered, out of plane, misaligned or otherwise non-conforming shall be removed and replaced at no additional cost to the Owner.

3.5 POOL FILLING AND EMPTYING

- A. Use a fill and drain rate of 2 feet per 24 hours to minimize thermal shock and structural movement. Maintain a temperature differential of 10 degrees Fahrenheit or less between the pool water and the substrate during fill and drain cycles.

3.6 REPLACEMENT TILE

- A. Provide Owner with approximately 10% or 25 square feet (whichever is least) of each color and type tile used on the project for Owner's repair and replacement requirements.

END OF SECTION

SECTION 131176
WATERSLIDES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Waterslide:
 - 1. Open Flume Waterslide
- B. Related Work Not in this Section:
 - 1. Cast-In-Place Concrete: Section 131120.

1.2 DESCRIPTION

- A. Work Included: Furnish and install fiberglass water slide as indicated on the Drawings, specified herein, and as necessary for proper completion including, but not necessarily limited to:
 - 1. All fiberglass flume components.
 - 2. All flume structural support systems.
 - 3. All tower, platforms, stairways, and related supports.
 - 4. Installation, supervision, ride testing, and certification.
 - 5. Labor, materials and equipment to complete the installation.
 - 6. Operations and Maintenance manuals.
 - 7. On-site training of entire Swimming Pool Staff.
 - 8. Proper signage as required.
- B. Related work specified elsewhere (to be completed by Contractor):
 - 1. All demolition and repairs to decks, fences, and landscaping.
 - 2. All electrical works, buildings, permits, and modifications (if any) to the pool wall.
 - 3. Supply and installation of mechanical equipment and related piping as necessary for slide operation.
 - 4. Complete access to job site.
- C. Concrete foundation design:
 - 1. Concrete foundation design shall be completed by the slide manufacturer and constructed by the general contractor or pool builder.
 - 2. Anchor bolts for the slide foundations shall be hot dip galvanized and supplied by the slide manufacturer.
- D. The slide structural steel supports and fiberglass shall be installed by the slide manufacturer or by the general contractor under the supervision of a manufacturer representative.

1.3 QUALITY ASSURANCE

- A. Qualifications of Suppliers and Personnel:

1. The water slide flume supplier shall have not less than five years' experience in the design and fabrication of similar tubular fiberglass water slides. The supplier shall provide appropriate performance and labor/material payment bonds if required and shall provide certificates of general liability and product liability insurance.
2. The water slide erection supervisor shall not have less than three years' experience in the erection of fiberglass water slides.
3. Product quality is of utmost importance.
4. Supplier shall provide insurance certificate illustrating a minimum of \$1,000,000 general and product liability per occurrence with a \$2,000,000 aggregate. In addition to this, the supplier shall send with this bid the proof of excess liability coverage for each occurrence in the amount of \$3,000,000. Supplier shall also provide proof of worker's compensation and employer's liability coverage with policy limits of \$1,000,000 per line item of coverage.
5. Dimensions, footing layout, and design will vary between manufacturers. Those items shown on plans and specified are intended to establish minimum standards.
 - a. For bidding purposes, equipment supplier shall anticipate deviations from items shown on plans and specified herein, and submit his or her bid accordingly.
 - b. Necessary design deviations shall be the responsibility of the equipment supplier and shall be made to fit manufacturer's specific requirements.

B. Codes and Standards

1. In addition to complying with all applicable codes and regulations, comply with pertinent recommendations contained in :
 - a. Water slide flumes shall comply with WWA's "Considerations for Operating Safety," as published by the World Water Park Association.
 - b. "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.
 - c. "Code for Welding in Building Construction" of the American Welding Society.
 - d. "Specifications for Architecturally Exposed Structural Steel" of the American Institute of Steel Construction.
 - e. "Manual of Standard Practice for Detailing Reinforced Concrete Structures," Publication ACI 315-99 of the American Concrete Institute.
 - f. "Specifications for Structural Concrete for Buildings," Publication ACI 301-99 of the American Concrete Institute.
 - g. ASTM requirements for all steel components of the American Society of Testing Materials.
2. Where provisions of pertinent codes and standards conflict with this specification, the more stringent shall govern.

- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with a minimum of three years of experience. Must meet all Workers Compensation requirements.

- E. Design waterslides under direct supervision of a Professional Engineer experienced in the design of this work and licensed in the State of California.
- F. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- G. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligation of the contract and to complete work described or if bidder does not have the qualifications stated herein.

1.4 SUBMITTALS

A. Engineering drawings

1. Within thirty days after award of contract, and before any materials are delivered to the job site, submit the following:
 - a. Engineered Drawings for approval by the City Engineer.
 - b. Architectural and Engineering team and Authority having Jurisdiction (AHJ).
 - 1) Slide path design with X, Y, Z (elevation) coordinates.
 - 2) Flume component details, including interface at the slide entry and exit.
 - 3) Flume structural support system details.
 - 4) Foundation plans and details as required for flume structural support. Foundations shall be concrete spread footing and pedestal design. Top of pedestal shall be one foot above finish grade.
 - 5) Mechanical schematic.
 - 6) Schematic for slide and pool wall interface.
2. Show all welds, both shop and field by the currently recommended symbols of the American Welding Society.
3. All shop drawings shall be certified and sealed by a Professional Engineer registered in the State of California where the slide is being constructed.
4. The slide manufacturer shall certify to the Owner that the depth, width, and length of the receiving pool is acceptable and compatible with safety standards for the manufacturer's designed product.
5. The slide manufacturer shall certify in writing on the shop drawings and bid proposal that no filler of any kind will be used to manufacture the fiberglass flumes.
6. The slide manufacturer shall certify to the Owner that the specified minimum width and length of the fiberglass flumes as described in PART 2, Section 2.01 "WATERSLIDE RIDES," Paragraph D, item 1, line "a" has been satisfied.

1.5 OPERATION AND MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS

- ##### A.
- Submit six (6) bound volumes of complete operating and maintenance instructions covering all installed equipment. Include wiring diagrams, lubrication and user maintenance instructions.

- B. Include manufacturer's recommended maintenance schedule, parts lists, piping diagram and troubleshooting information.
- C. Include one (1) set of approved submittals as a part of each O & M manual.
- D. Certification letter: Provide a certification letter from the slide manufacturer to the owner stating that the slide has been installed properly and is functioning according to the slide manufacturer's recommendations.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Deliver manufactured materials to site in manufacturers' original unbroken packages or containers bearing manufacturers' name and brand labels. Keep cementitious materials dry until ready to be used and stored off the ground, under cover, and away from damp surfaces.

1.7 GUARANTEE/WARRANTY

- A. All work of this section shall be warranted against all defects of material and/or application for a period of one (1) year from the date of acceptance. Any failures that may occur within this warranty period, due to defective installation and/or materials, shall upon written notification of such failure be immediately repaired or replaced.

PART 2 - PRODUCTS

2.1 WATERSLIDE RIDES

- A. Fiberglass Laminate Materials:

1. Gelcoat

- a. Interior gelcoat shall be high quality isophthalic polyester with U.V. inhibitors 18 to 20 mils thick ride surface, 20 mils exterior coating. Translucent fiberglass shall also have exterior UV protection clear coat.

2. Resins

- a. Thixotropic promoted low profile polyester resin with alternate layers of continuous roving chop and 18 oz. woven roving. No filler shall be allowed in the fiberglass laminate materials.

3. Structure

- a. Fiberglass lamination with sandwich panel centerline reinforcement. Standard flume section shall be 3/16" thick and have a minimum weight of 20 oz. per square foot. Flanges shall be a minimum of 3/8" thick and extend at least 4 3/4" from the slide surface, "L" type.

- 4. No fillers to be used anywhere in the process.

- B. Joints, Connections, and Seams:

- 1. Flume to flume joints shall be fastened with 3/8" stainless steel bolts, washers (2 per bolt), and self-locking nuts.

2. Flue to support system connections shall be made with stainless steel hardware and shall be connected separately from water slide section connections to the exterior flange of the flume.
 3. All connections shall be external to flume interior. No connection, hardware, or penetration shall be made to flume interior.
 4. Fiberglass joint connections shall be made using waterproof of non-shrink caulking with suitable adhesion to fiberglass. Silicone sealants will not be permitted. Caulking shall be supplied by the slide manufacturer.
 5. Fiberglass over seams within the riding surface is not permitted. Sanding within the slide surface should be minimized to maintain adequate gel coat thickness and gloss. Any sanded areas shall be polished to a high gloss until undetectable.
- C. Color: Shall be integral to the fiberglass. The color shall be selected by the owner from the 40 colors on the CCP, Inc. Gelcoat color chart. Color may be different inside and outside if desired on the open flume as well as the closed slide.
- D. Water Slide Configuration(s):
1. The outdoor open flume water slide shall have an approximate slide length of 147'-7" lineal feet at the centerline drop into the Teaching Pool approximately 0'-4" above water level, and consist of multiple turns, entry sections and straight sections as shown on the project plans.
 - a. Basis of Design: The slide layout and design has been developed and provided by Splashtacular, Inc.,
- E. Required Components:
1. Entry trays shall be pre-plumbed for water injection downstream of the rider entry point. Rider entry areas shall be a non-skid surface, no steps are permitted.
 2. Water slides shall be constructed so that water loss does not occur. Risers or built-up sections are required on open flume slides for ride safety and to control water loss and shall be provided on all curved flume sections. Risers shall be integral to the flume. Bolt on sections will be acceptable.
 3. Riser ends to provide a smooth transition at the beginning and ending of each riser. Riser ends shall be provided integral to the flume section.
 4. The flume shall be perpendicular to the pool wall for at least ten feet from the end and shall not slope greater than one foot vertical in last ten feet.
 5. Pool entry sections shall provide a smooth finished end piece, at least 1'-6" long, which provides safe pool entry and masks any hardware or connection to the pool. Entry flume section shall terminate between six inches below and two inches above the water level. Entry flume section shall have a skirt returning to the pool wall.
 6. Factory pre-drilling of all sections.
 7. Waterproof joint sealant as described.
 8. Stainless steel assembly hardware.
- F. Flume Structural Support System:
1. Structural steel support columns, arms, and coos bracing as required by the design to support all base bid flumes and connection to base bid columns required for future or alternate flume shall be supplied in base bid. All steel components shall be hot dip galvanized on coat of prime with a factory applied epoxy coating. Tnemec Series 27 Typox at 3.0 to 5.0 dry mils per coat, two finish coats of Tnemec

- Series 73 Endura-Shield at 2.0 to 3.0 dry mils per coat or powder coated and designed for bolt-up installation.
2. Connecting hardware and yokes as required by the design. Connecting hardware to attach the slide to structural components shall be 1/2" stainless steel, nuts, bolts, and washers. Yokes for connecting flumes to structural elements shall be 1/4" thick, 3" x 3" galvanized steel angle bent to match the exterior flume flange as a minimum standard.
 3. Slide manufacturer shall design all concrete footings, foundations, and columns as required for the water slide design. Slide manufacturer shall submit a foundation layout plan showing quantities, dimensions, and typical details with his bid.
- G. Column Support System:
1. A single or multiple column system shall be used.
- H. Waterslide Tower and Stairway Section:
1. The Waterslide Tower and Stairway Section shall consist of:
 - a. A steel top deck, stair and support system supporting the starting chute for the indoor/outdoor slide(s). Guard railing, balustrades and handrails shall be galvanized steel tubing.
 - b. Columns, crossbracing, tension rods, and stairway supports shall be hot dipped galvanized (and painted as described above), designed, and pre-fabricated for bolt-up installation.
 - c. Guardrailing balustrades and handrails shall be galvanized steel tubing.
 - d. Concrete Foundation, columns and flatwork as required by design.
 2. Structural Systems
 - a. Structural supports, tower and walkway systems shall be designed to safely support these facilities given the design criteria shown on sheet WS1.0. Other criteria may be required by local regulatory authorities.
 - b. All concrete footings shall have a minimum 28 day compressive strength of 4,000 psi.
 - c. Bolts and nuts:
 - 1) High Strength Bolts:
 - i. All high strength bolts shall meet the requirements of ASTM A-325.
 - ii. Use high strength friction bolts for all bolted connections unless otherwise indicated.
 - iii. Make bolt holes 1/16 inch larger than nominal bolt diameter.
 - 2) Anchor Bolts:
 - i. All anchor bolts shall meet the requirements of ASTM A-36.
- I. Steel Protection:
1. All steel shall be hot dip galvanized for maximum corrosion protection. All steel components shall be hot dip galvanized on coat of prime with a factory applied epoxy coating. Tnemec Series 27 Typox at 3.0 to 5.0 dry mils per coat, two finish

coats of Tnemec Series 73 Endura-Shield at 2.0 to 3.0 dry mils per coat and designed for bolt-up installation. To be done in the factory.

2. Starting Tower

- a. Starting tower structure shall be constructed of a galvanized steel support deck with a slip resistant finish surface consisting of pultruded fiberglass deck with an integral bottom plate. Coordinate design with building structural engineer and slide manufacturer.
- b. Awning structure to cover upper slide platform that is designed for local wind loads shall be provided. Awning shall be high density knitted polyethylene cloth with an epoxy painted steel frame to support the structure. Bottom of awning shall be no less than 7.6 feet above platform. Awning color shall be selected by Architect.

3. Stairs and Railings

- a. Prefabricated stairway sections shall include stringers constructed of hot dip galvanized steel. Stair treads landings shall be 40 inch wide and shall be of non-corrosive and impervious pultruded fiberglass with integral riser and bottom plate and with appropriate non-slip surface.
 - 1) Colors to be chosen by Architect from waterslide manufacturer color chart.
- b. Rail system shall be a minimum of 42 inches high at any point, including height above starter tub section, non-climbable and designed to prevent accidental exit. Railing must surround top platform on all sides (except at slide start area) and along stair section from the top platform area down to the bottom of the finish deck. Guardrailing, handrails and balustrades shall be painted galvanized steel tubing.
- c. A swing gate with self-closing hook and sign labeled "CLOSED" shall be provided across the stair entry point on the deck of the waterslide.

J. Platform Cover

- 1. The upper platform and slide entry sections shall be protected from the sun by a domed galvanized pipe frame covered with acrylic fabric or woven vinyl impregnated polyester yarn. Fabric shall be attached to the pipe frame using brass grommets and white rope. Bottom of shade shall be 7 foot 6 inches above entry tub.

K. Safety Signage

- 1. Water slide manufacturer shall provide two signs per slide tower listing safety rules and riding instructions. Sign shall be a rigid plastic or aluminum material suitable for exterior installation. Mount one (1) sign at the top platform and one (1) at the stair base. Both slide rule signs shall be clearly visible to the slide users.

L. Finish

1. All ferrous metal parts (All steel components of water slide are to be factory painted with field touch-up as required).
 - a. Surface Preparation
 - 1) Blast all surfaces to be coated to the extent of an SSPC-SP6 commercial-grade level of cleanliness. Create a 1.5 – 2.0 mil profile and prime before any rust bloom forms on the surface.
 - b. Primer
 - 1) Apply spray in the shop, one full coat of Tnemec Series 90-97 Aromatic Urethane Zinc-Rich or Amercoat 68 HS primer to a DFT of 4.0 mils. Allow to cure as per data sheet (4 hours at 75 degrees F) before applying top coat.
 - c. Top Coat
 - 1) Apply spray in the shop, one even finish coat of Tnemec Series 74-Color Endura-Shield. Acrylic Polyurethane or Ameron PSX-700 finish to a minimum DFT of 5.0 mils. Allow to cure as per data sheet (6 hours at 75 degrees F) before handling/loading in the shop.
 - d. Field Touchup
 - 1) If the broken area of the shop applied film is rough from scaring, disc-abrade that area smooth and then solvent clean it as per SSPC-SP1 level of cleanliness. Brush or roller apply one coat of Tnemec Series 135 Chembuild or Ameron epoxy primer. Allow to cure as per data sheet. Brush or roller apply one coat of Tnemec Series 74 or Ameron PSX-700 shop applied color to bring the film up to specification thickness.
2. Piping
 - a. All above grade plumbing to be Schedule 80 PVC, unless otherwise noted. Refer to drawings for sizes and connection details.
 - b. All above grade waterslide piping to be painted to match waterslide tower color. Paint and primer to be approved for painted PVC application. Primer to be Pro Shield Waterborne Primer/Sealer (05-208) as manufactured by Columbia Paint & Coating; paint to be Industrial Acrylic DTM Polyurethane (05-502) as manufactured by Columbia Paint & Coating or approved equal. Contractor to confirm color with Architect on site prior to painting.
3. Top deck and landings shall have a non-slip finish.
4. The stair system and treads shall consist of prefabricated stairway sections with stringers constructed of hot dip galvanized steel. Stair treads and landings shall be of non-corrosive and impervious pultruded fiberglass with integral riser and bottom plate and with appropriate non-slip surface. All stair treads and platform shall have a slip-resistant finish.
5. All exposed concrete vertical surfaces shall have an exposed aggregate finish.

6. Seal all concrete with a minimum of two (2) coats of H&C silicone acrylic concrete sealer, FLR Paints, Inc., 6104 31st St., East Bradenton, FL.
7. Colors shall be selected by Owner and Architect/Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 1. Prior to installation of the work of this section, carefully inspect the installed work of other trades and verify that all such work is complete to the point where this installation may properly commence.
 2. Verify that fiberglass slides and structural support systems may be fabricated and erected in strict accordance with the original design.
- B. Discrepancies:
 1. In the event of discrepancy, immediately notify the Engineer.
 2. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies are fully resolved.

3.2 FABRICATION

- A. General: Fabricate all water slides and structural support systems in strict accordance with Shop Drawings and referenced standards.
- B. Use of dissimilar metals in contact shall not be permitted.

3.3 INSTALLATION OF FOOTINGS AND FOUNDATIONS

- A. Foundations shall be in strict accordance with the Shop Drawings. All supplies, labor, and installation will be the sole responsibility of others and not the responsibility of the slide manufacturer. The waterslide manufacturer will supply galvanized anchor bolts. Install in accordance with the manufacturer's structural drawings and instructions.

3.4 INSTALLATION & SUPPLY OF HYDRAULIC PACKAGE

- A. Hydraulic Piping and Fitting must be Schedule 80 PVC. Schedule 40 piping will not be allowed. Hydraulic system buried piping must be hydrostatically tested at 100 psi for one hour, then the pressure reduced to 30 psi for the duration of construction.

3.5 WELDING

- A. General
 1. For details of joints, comply with requirements for AWS joints accepted without qualification ties.
 2. Field welds will not be permitted.
 3. Use E-70XX series electrodes.
 4. Follow applicable sections of AWS specifications.
- B. Types of Welds (unless otherwise noted):

1. Make all fillet welds 1/4" minimum.
2. Make all butt welds full penetration welds.

3.6 ERECTION

A. General

1. Erect all fiberglass slides and structural support systems in strict accordance with the shop drawings and all pertinent regulations and standards.

B. Tolerance

1. Align all structural steel straight, plumb, and level with a tolerance of 1 in 500.

C. Fiberglass Joints

1. All flange to flange connections shall be made utilizing the waterproof caulking supplied by the fiberglass manufacturer and shall be joined in such a way as to provide for a safe and matless ride. All joints shall be aligned for a completely smooth riding surface. Alignment must be within 1/64" and in no case shall the downstream side of the joint be above the upstream side of the joint.

D. Steel finishes

1. All steel components to be hot dipped galvanized for maximum corrosion protection. Any scarred surfaces shall be cleaned and cold galvanized with zinc rich paint.

3.7 CLEAN-UP

- A. Upon completion of the work of this section, immediately remove all fiberglass, debris, and rubbish occasioned by this work to the approval of the owner and at no additional cost to the owner.

3.8 START-UP AND INSTRUCTION

- A. Supply the services of an experience operator/instructor after waterslides have been completed and initially placed in operation. During this period, the Owner's representatives who will be operating the pool shall be thoroughly instructed in all phases of the slide operation. Prior to leaving the job, obtain written certification from the designated Owner's representative acknowledging that the instruction period has been completed and necessary operating information provided. A minimum of one (1) 2-hour session is required.

3.9 OWNER INSTRUCTION

- A. Manufacturer shall train owner's personnel in the operation and maintenance of the waterslide at the job site during pool start-up.

END OF SECTION

SECTION 131180
SPRAY GROUNDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 - Specification Sections, apply to the work specified in this section.

1.2 SUMMARY

- A. Furnish all labor, material, equipment and services for installation of the water spray ground including splash pad areas, water features, controllers, programming software and all spray ground recirculation mechanical system components.
- B. The outdoor water spray ground shall have an approximate area of 1,000 square feet including the various water play features as indicated in these specifications as well as swimming pool drawings.
- C. Design, furnish and install water pad structure and install final finishes to this surface.
- D. Furnish and install the water spray ground systems as indicated on the swimming pool drawings, specified herein, and as necessary for proper completion including, but is not necessarily limited to:
 - 1. All water spray features.
 - 2. All activation devices.
 - 3. All controllers.
 - 4. Supply and installation of mechanical equipment and pool piping as necessary for spray ground operation.
 - 5. Operations and maintenance manuals.
 - 6. On site startup training.
 - 7. Proper signage as required.
- E. Related Work Specified Elsewhere
 - 1. All demolition and repairs to decks, fences and landscaping.
 - 2. All electrical works, buildings and permits.

1.3 QUALITY ASSURANCE

- A. The supplier shall demonstrate their specific experience and competency in the manufacturing and installation of the water spray ground equipment and systems.

- B. The supplier shall have completed at least five installations comparable to the system specified herein within the last 5 years. Submit a list of such projects with name, address and current telephone number of the Owner's Operator and Architect of Record to the Architect with bid on the bid date.
- C. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligation of the contract and to complete work described or if bidder does not have the qualifications stated herein.

1.4 REGULATORY AGENCY REQUIREMENTS AND ENGINEERING SERVICES

- A. The entire water spray ground system shall be designed and installed to meet all national and local codes and be in compliance with applicable sections of the American National Standards Institute / National Spa and Pool Institute (ANSI /NSPI-2 1999).
- B. The system shall comply with all necessary approvals obtained by the Architect from local regulatory agencies governing the design and construction of public swimming pools.
- C. The Contractor shall give all necessary notices, obtain all permits and pay all government fees, and other costs in connection with his work; file all necessary drawings, prepare all documents and obtain all necessary approvals of governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Architect before request for acceptance and final payment for the work.
- D. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.
- E. Where provisions of pertinent codes and standards conflict with this specification, the more stringent shall govern.

1.5 COORDINATION AND CLARIFICATION

- A. Coordinate with other trades affecting and affected by work in this section.
- B. The Contractor must establish with other contractors or subcontractors, having related work in this Section, that all work necessary to complete the sprayground as shown on the drawings and in the specifications is included in the base bid and alternates to the Owner.

- C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.6 CONTRACTORS ALTERNATIVE PROPOSAL

- A. Suppliers to submit their bid based on materials, equipment and methods as specified in this section. Any substitutions of material, equipment or method must be submitted in accordance with the specified procedure described in Division 1. Any required changes to the construction documents shall be described in writing and any costs or changes must be included in the price quoted to complete the installation.

1.7 SUBMITTALS

- A. Division 1 requirements.
- B. Shop Drawings
 - 1. Provide a complete set of checked shop drawings required to fabricate and assemble all water sprayground systems.
 - 2. Statements
 - a. Furnish the Owner with copies of all permits and receipts for fee payments.
 - 3. Test Reports
 - a. Submit a sample form of any performance test reports that will be used by the installer following the water sprayground erection, prior to beginning of installation.
- C. Include complete product data indexed, tabbed and referenced to specifications.
- D. Submit details indicated the water spray elements, activation devices, controllers, as well as any necessary flow regulation devices necessary to operate the water sprayground system as indicated by the manufacturer.
- E. Specify water supply requirements and required pump characteristics to Architect, for approval, prior to preparation of fabrication drawings.
- F. Guarantee / Warranty
 - 1. All work of this section shall be warranted against all defects of material and/or application for a period of one (1) year from date of acceptance. Any failures that

may occur within this warranty period, due to defective installation and/or materials, shall upon written notification of such failure be immediately repaired or replaced.

1.8 MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS

- A. Submit six (6) bound volumes of complete Operating and Maintenance instructions covering all installed equipment. Include wiring diagrams, lubrication and user maintenance instructions.
- B. Include manufacturer's recommended maintenance schedule, parts lists, piping diagram and troubleshooting information.
- C. Include one set of approved submittals as a part of each O & M manual.
- D. All submittals must also meet the requirements set forth in other accompanying swimming pool specifications such as 131100 – Swimming Pool Equipment.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver material in manufacturer's original, unopened containers and crates with all labels intact and legible.
- B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.
- C. Handle materials in a manner to prevent damage.
- D. Store all materials on clean raised platforms with weather protective covering when stored outdoors. Provide continuous protection of materials against damage or deterioration.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The specified water sprayground elements shall be provided in the locations as provided in the swimming pool drawings and specified hereinafter. The water sprayground elements shall be manufactured by Splashtacular. Vortex, Aquatix, Water Odyssey, or Raindrop Products may be considered equals provided they meet the design intent and

are approved by the engineer. The supplier shall furnish water sprayground features complete with all anchoring and fastening devices, required gaskets, controllers, programmers and program software. Pump and installation shall be supplied by others.

2.2 SPRAYGROUND COMPONENTS

A. The following Water Sprayground items shall be included.

1. TIPPY BUCKET – 3-WAY SPRAY (1 required)
 - a. Model number TRE-TB3.
 - b. Interactive water effect shall consist of three bucket dumps at random.
 - c. Housing shall consist of 1.5" NPT bottom connection, grounding lug, and stainless steel anchor bolts with leveling nuts and washers.
 - d. Feature to be 10'1" high with an 11'0" diameter spray zone.
 - e. Hydraulic Requirements – 30 GPM.
2. PEDESTAL BLASTER – (2 required)
 - a. Model number GND-PBT.
 - b. Interactive water effect shall consist of a directionally adjustable arching stream of water.
 - c. Housing shall consist of a with 1" NPT bottom connection, grounding lug, and stainless steel anchor bolts with leveling nuts and washers.
 - d. Feature to be 3'1" high with a 15'0" diameter spray zone.
 - e. Hydraulic Requirement – 20 GPM.
3. WATER DOME – (1 required)
 - a. Model number BOL-WD.
 - b. Interactive water effect shall consist of a dome spray.
 - c. Housing shall consist of a with 1.5" NPT bottom connection, grounding lug, and stainless steel anchor bolts with leveling nuts and washers.
 - d. Feature to be 3'10" high with a 6'0" maximum diameter spray zone.
 - e. Hydraulic Requirement – 40 GPM.
4. RADIAL JET BOLLARD – (1 required)
 - a. Model number BOL-RJ.
 - b. Interactive water effect shall consist of a four sprays.
 - c. Housing shall consist of a with 1.5" NPT bottom connection, grounding lug, and stainless steel anchor bolts with leveling nuts and washers.
 - d. Feature to be 3'9" high with a 6'0" maximum diameter spray zone.
 - e. Hydraulic Requirement – 30 GPM.
5. BLADE SPRAY DOWN JETS – (1 required)
 - a. Model number GND-BSD.
 - b. Interactive water effect shall consist of a downward sheet of water.
 - c. Housing shall consist of a with 1.5" NPT bottom connection, grounding lug, and stainless steel anchor bolts with leveling nuts and washers.

- d. Feature to be 7'5" high with a 11'5" maximum diameter spray zone.
- e. Hydraulic Requirement – 20 GPM.

6. DIRECTIONAL JET POP – (3 required)

- a. Model number FM-DJ.
- b. Interactive water effect shall consist of a floor mounted vertical jet spray.
- c. Housing shall consist of a with 1" NPT bottom connection, grounding lug, and stainless steel anchor bolts with leveling nuts and washers.
- d. Feature to be floor mounted with a 4'0" maximum diameter spray zone.
- e. Hydraulic Requirement – 5 GPM.

7. GUSHER DECK JET – (3 required)

- a. Model number FM-GJ.
- b. Interactive water effect shall consist of a floor mounted vertical gusher spray.
- c. Housing shall consist of a with 1.5" NPT bottom connection, grounding lug, and stainless steel anchor bolts with leveling nuts and washers.
- d. Feature to be floor mounted with a 6'0" maximum diameter spray zone.
- e. Hydraulic Requirement – 20 GPM.

2.3 SPRAYGROUND ACTIVATORS – The following Water Sprayground Activators shall be included.

A. Push Button Activator (Wired) (1 required)

- 1. Activator shall be a 2'8" high bollard with push button mounted on the top.
- 2. Anchors shall consist of four, ½"-13 stainless steel concrete anchors with tamper resistant 18/8 bolt.
- 3. Activator cord shall be 150 Feet in minimum ¾" conduit.

B. TOUCH & GO (Wireless) (x required)

- 1. Model number W009-W.
- 2. Shaft shall consist of a straight 4.5" diameter type 304 stainless steel with machined type 304 base plate.
- 3. Solid state transmitter with encoded signal and integral omni-directional antenna.
- 4. Anchors shall consist of four, ½"-13 stainless steel concrete anchors with tamper resistant 18/8 bolt.
- 5. Fasteners shall be tamper resistant 18/8 stainless steel.
- 6. Finish shall consist of a textured aliphatic urethane with a UV and chlorine resistant sealer coat.
- 7. Color shall be red, dark blue, light blue, yellow, green, orange, or purple.
- 8. Nozzles (12) shall be precision machined brass.
- 9. Activator power shall be a 9 VDC alkaline battery.

2.4 SPRAYGROUND CONTROLLERS

A. CONTROLLER (1 required)

- 1. Housing shall be NEMA 4X with lockable hasp.
- 2. Functions shall include timed duration, cycled, defined, field adjustable.

3. Programming shall be through keyboard or with Windows based computer using Waterscript CD for click and drag modification of programs and operating hours. Program uploads to WDC Controller through serial port
4. Input voltage shall be 120VAC/60 Hertz, 20 Amps.
5. Output voltage shall be 24VAC/60 Hertz/200 Max. VA.
6. Wired activator input shall be 12VDC.
7. Power cord shall be 6 foot, 16-3 type SJT with grounded plug.
8. Time clock shall be integral, electronic, 7 day, 24 hour.
9. Interface shall be a keypad with 20 keys and a 4 x 20 backlit LCD display.
10. Maximum number of wired inputs shall be 8.
11. Maximum number of solenoid outputs shall be 16.
12. Computer connection shall be 9 pin, RS-232, serial port.
13. The controller shall be Underwriters' Laboratories listed.

PART 3 - EXECUTION

3.1 SYSTEMS INSTALLATION

- A. The water sprayground installer shall assemble and install all equipment, special parts and accessories in accordance with these specifications and detailed layouts and shop drawings of equipment supplier.
- B. Installer shall furnish and install all anchors and inserts to be imbedded including all fittings, inserts, structure sleeves and required anchorages.
- C. Install all equipment and systems in accordance with manufacturer's directions.
- D. The water sprayground shall be as described in the specifications. Items are detailed and specified as a guide reference and for dimensional purposes. The Contractor must make provisions accordingly and submit shop drawings and submittals based on that data.
- E. Installer shall coordinate, supervise and approve work by other trades responsible for work related to this section. All work in this section shall be performed by the water sprayground installer except as noted.

3.2 SITE CONDITIONS

- A. Inspection
 1. Prior to installation of the work of this section, carefully inspect the installed work of other trades and verify that all such work is complete to the point where this installation may properly commence.
 2. Verify that all sprayground water spray features may be fabricated and erected in strict accordance with the original design, the approved shop drawings and the referenced standards.

B. Discrepancies

1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies are fully resolved.

3.3 FABRICATION

- A. Fabricate the water sprayground and its related systems in strict accordance with the approved shop drawings and referenced standards.

3.4 CLEAN-UP

- A. Upon completion of the work of this section, immediately remove all fiberglass, debris and rubbish occasioned by this work to the approval of the Architect and at no additional cost to the Owner.

3.5 START-UP AND INSTRUCTION

- A. Supply the services of an experienced operator/instructor to assist in the initial start-up and training of the water sprayground and its related systems has been completed and initially placed in operation. During this period, the Owner's representatives who will be operating the pool shall be thoroughly instructed in all phases of the water sprayground operation. Prior to leaving the job, obtain written certification from the designated Owner's representative acknowledging that the instruction period has been completed and all necessary operating information provided. A minimum of one (1) 2-hour session is required. Manufacturer of sprayground equipment shall have an on site representative for the commissioning of the water sprayground.

3.6 WARRANTY

- A. Shall be furnished by manufacturer providing a five year unconditional warranty against all defects in workmanship, materials and equipment operations for a period of one year from system start-up.

3.7 INSTALLATION

- A. Drawings and instructions shall be supplied by manufacturer for ease of installation. Manufacturer shall supply a service technician to be on site at the time of system startup to ensure spray patterns are correct, lines are free and clear, water pressures are correct, the dynamic control module is programmed correctly, play events are correct and facility staff is properly trained on the operations of the dynamic module controller.

3.8 CONCLUSION

- A. It is the intention of these specifications to provide a complete installation of the water spray ground as described. All accessory construction and apparatus necessary or advantageous in the operation or testing or high performance of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving the water spray ground supplier or installer from furnishing and installing such parts. Any such omission or clarification shall be brought to the attention of the Architect prior to bidding.

END OF SECTION

SECTION 22 00 00

PLUMBING

PART 1. GENERAL

1.1 DESCRIPTION

A. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 23 00 13 General Commissioning Requirements.
3. Where the requirements of the Section exceed those in other Contract Documents, Contractor shall comply with the requirements of this Section.

B. Codes and Regulations:

1. In addition to complying with the specified requirements, comply with pertinent regulations of the Authority Having Jurisdiction. All work must comply with the version of the code that was in effect at the time of the initial permit application date.

- a. CALGreen – California Green Building Standards Code
- b. CBC – California Building Code
- c. CEBC – California Existing Building Code
- d. CEC – California Electrical Code
- e. CEnC – California Energy Code
- f. CFC – California Fire Code
- g. CMC – California Mechanical Code
- h. DPH – Department of Public Health
- i. DWR – Department of Water Resources
- j. DSA – Division of the State Architect
- k. NFPA – National Fire Protection Association
- l. Reach Codes that have been adopted by the Authority Having Jurisdiction
- m. Local Building Department
- n. Local Fire Marshall

C. Included: Work includes, but is not limited to, the following.

1. The Work covered by this Specification shall include furnishing labor, material, equipment, and services to construct, install and place in operation, the complete Plumbing Systems to the extent as indicated, and as shown on the Drawings and specified herein. The Work covered under this Section shall hereinafter be referred to as the Plumbing System.

- a. WASTE AND VENT
 - 1. Soil piping
 - 2. DWV - Drain Waste and Vent Piping
 - 3. Indirect waste piping
 - 4. Floor drains.
 - 5. Traps.
- b. SEWERS (To five feet beyond building)
 - 1. Including metallic or non-metallic piping used to convey sewage and other waste to, and including, connection with offsite utility or onsite treatment and disposal system.
 - 2. Manholes (pre-cast or pre-formed), cesspools, septic tank systems, and leaching lines, backwater valves and lift stations.
- c. WATER
 - 1. Potable water piping systems including above and below grade tanks, pressure reducing valves, relief valves, balancing valves, water hammer shock absorbers, air chambers.
 - 2. Isolation, Zone and Control Valves.
 - 3. Hot water systems including heaters.
 - 4. Disinfecting of water systems.
 - 5. Insulation of piping and equipment for heat, sound, and vibration.
- d. ALL PLUMBING FIXTURES AND SUPPORTS
 - 1. Including, but not limited to:
 - (a) Supports (backing) for all plumbing fixtures and accessories
- e. FUEL GAS PIPING
 - 1. Natural and manufactured gas distribution, liquefied petroleum distribution, meters, regulators and connections to all gas fired equipment.
- f. PIPE IDENTIFICATION
 - 1. Refer to section 23 00 13
- g. CONNECTIONS
 - 1. Utilities-Sanitary sewer, storm drain, water, gas
 - 2. Make-up water for heating and cooling systems
 - 3. The joining of pipe by any mode or method including, but not limited to, acetylene and arc welding, brazing, lead burning, plastics welding, soldering, wiped joints, caulked

joints expanded or rolled joints, etc., used in connection with any of the work listed herein.

h. LAYOUT AND CUTTING

1. Holes, chases, channels, the setting and erection of bolts, inserts, stands, brackets, stanchions, supports, sleeves, escutcheon plates, thimbles, hangers, conduits, and boxes.

i. EXCAVATION, TRENCHING AND BACKFILL

1. In connection with plumbing and piping work shown herein

j. TEMPORARY PIPING in connection with:

1. Building and construction work
2. Excavating and underground construction

k. PIPE HANGERS, SUPPORTS, ANCHORS, GUIDES, EXPANSION JOINTS

1. Including:
 - (a) Supports for equipment to which pipe is connected, such as tank supports
 - (b) Isolators-dielectric and vibration
 - (c) Anchors and thrust blocks of concrete, metal, etc.
 - (d) Seismic bracing
 - (1) Anvil/Badger, Mason Industries, B-Line/TOLCO or approved equal.
 - (2) Seismic hanger system design shall comply with the 2022 CBC requirements and ASCE 7-16.

l. SIGNS AND NOTICES

m. ROOF FLASHINGS FOR PIPING PENETRATIONS

n. TESTS

1. Piping, for tightness
2. Equipment for performance
3. Operating instructions
4. Final operation

1.2 ACCESSIBLE PLUMBING FIXTURES

- A. Accessible plumbing fixtures shall comply with all of the requirements of the 2022 CBC 11B-213, 11B-305, &11B-308.

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the

specified requirements and the methods needed for proper performance of the Work of this Section.

- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the Work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. Welder's Qualifications: Comply with ASME B31.8. The pipe welder shall have a copy of a certified ASME B31.8 qualification test report. Contractor shall also conduct a qualification test. Submit each welder's identification symbols, assigned number, or letter, used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this contract.

1.4 SUBMITTALS

- A. Comply with pertinent provisions of Architectural Sections.
- B. Product Data: Within 35 calendar days after the Contractor has received the Notice to Proceed, submit to the Architect for approval prior to acquisition:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications, cut sheets, and other data needed to prove compliance with the specified requirements. All pieces of equipment shall be clearly identified on corresponding manufacturer's literature being submitted. All information for each item shall be correlated.
 - 3. Shop Drawings or other data as required to indicate method of installing and attaching equipment and piping, except where such details are fully shown on the Drawings.
 - 4. Submittals for the entire Project shall be submitted at the same time. Incomplete or noncompliant submittals may be rejected.
 - 5. Submittals shall be provided in PDF format.

1.5 DESIGN CHANGES CAUSED BY PRODUCT SUBSTITUTIONS

- A. If the domestic water heater is substituted with a different brand or model than what is specified on the Drawings the Authority Having Jurisdiction may require the energy compliance calculations to be updated. The contractor shall be responsible for all costs related to updating the calculations. If the substituted equipment does not comply, the contractor shall be responsible for providing equipment that meets or exceeds the performance of the specified equipment at no additional cost to the owner.
- B. Contractor shall pay costs of design and installation for changes resulting from substitution of alternate products.
- C. Acceptance of alternate products by Architect does not change this requirement.

1.6 PRODUCT HANDLING

- A. Comply with pertinent provisions of Architectural Section

PART 2 – PRODUCTS

2.1 WASTE, VENT, SEWER AND STORM DRAINAGE

A. Above Grade

1. All waste, vent, sewer and storm lines shall be of cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888 or ASTM A-74 for all pipe and fittings. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.
 - a. Acceptable Manufacturers:
 1. AB&I Foundry
 2. Charlotte Pipe and Foundry
 3. Tyler Pipe Company
 - b. Joints
 1. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions and local code requirements. Hubless coupling gaskets shall conform to ASTM Standard C-564 and be listed with NSF International. Couplings shall consist of a 304 stainless steel shields, clamp assembly and a high quality elastomeric gasket conforming to ASTM 564. Clamp shall be 4 band construction, Husky HD 4000 or approved equal.
 - c. Mandatory Referenced Standards
 1. Cast Iron Soil Pipe Institute Standard Specifications - Latest Issue
 - (a) CISPI 301: Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - (b) CISPI 310: Couplings for use in connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 2. ASTM Standard Specifications - Latest Issue
 - (a) A-888: Standard Specifications for Hubless Cast Iron Soil Pipe and Fittings.
 - (b) C-564: Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

B. Below Grade:

1. Schedule 40 Solid wall PVC plastic DWV pipe with solvent-cemented drainage pattern fittings complying with ASTM D 1785 - Latest Issue.

- a. SCH. 40 Solid Core PVC plastic DWV pipe with solvent-cemented drainage pattern fittings complying with ASTM D 4396 may be used at Contractor's option for vent piping. -Latest Issue.
 - 2. Schedule 40 Solid wall ABS plastic DWV pipe with solvent-cemented fittings complying with ASTM D-2661 - Latest Issue.
 - a. SCH. 40 Solid Core ABS plastic DWV pipe with solvent-cemented drainage pattern fittings complying with ASTM D 3965 may be used at Contractor's option for vent piping. -Latest Issue.
- C. Condensate (sized per CMC) and indirect waste drains
 - 1. Type L Copper Water Tube ASTM B88 with wrought Copper solder fittings, ANSI-B16.22

2.2 DOMESTIC WATER PIPING

- A. Below Grade (Water Service)
 - 1. 3" NPS and smaller, Schedule 40 PVC Plastic Pipe and fittings. ASTM D1785, D2466, with Solvent Cement Joints ASTM D2564.
- B. Above Grade (Distribution System)
 - 1. Piping
 - a. For soldered, brazed and mechanical joints, 4" and smaller Copper Water Tube Type L Annealed Temper (Hard Drawn) ASTM B75 or ASTM B88.
 - 2. Fittings
 - a. Wrought Copper Pressure Solder Fittings, ASME B16.22 or ASME B16-25, 95-5 Tin-Antimony Filler Metal.
 - b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - c. Copper Unions: MSS SP-123, cast-copper alloy, hexagonal-stock body, with ball-and-socket, met-to-metal seating surfaces, and solder-joint or threaded ends.
 - d. Press Fitting: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Press fittings shall have an inboard bead design.
 - 1. Copper Press Fittings: Viega/Rigid Tool Company, NIBCO, Elkhart/Apollo Xpress or approved equal.
 - 2. 2"NPS and smaller: Wrought copper fitting with EPDM-rubber O-ring seal in each end.
 - 3. 2-1/2" to 4"NPS: Cast-bronze or wrought copper fitting with EPDM-rubber O-ring seal in each end.
- C. Below Grade (Distribution System)
 - 1. Piping
 - a. All underground water piping within the building boundaries and distribution to outdoor showers shall be ASTM B88-93a Type "L"

annealed (soft) copper tube made up without fittings below the floor level.

2.3 GAS PIPING

A. Below Ground

1. Polyethylene (PE) Natural and Liquefied Petroleum Gas Yard Piping ASTM D2513 with Fusion Joints. Provide Steel Transition Risers and Detectable Warning Tape.

B. Above Ground

1. Schedule 40, Seamless Black Steel Pipe ASTM A 120 2 1/2" and smaller with Malleable Iron Threaded fittings ANSI B16.3 Class 150.
2. Schedule 40, Seamless Steel Pipe 3" and larger. ASTM A53 with Buttweld Steel fittings ASTM A 234.

2.4 VALVES

- A. Acceptable Manufacturers: Milwaukee, Hammond, NIBCO, Jomar, Watts, others as noted.

Type	Size Range	Part Number
Ball	2" and smaller (2 piece)	Milwaukee UPBA400 Hammond UP8301A NIBCO 585-80-LF
Ball	2-1/2" and larger (3 piece)	Milwaukee UPBA300 Hammond UP8604 NIBCO 595Y-LF
Note: Stem extensions of non-thermal-conductive material and protective sleeve that meets UL 2043 approved for inside air plenum and allows operation of the valve without breaking the vapor seal shall be used on insulated pipe. NIBCO NIB-Seal handle or acceptable equal.		
Gate	2" and smaller	Milwaukee UP115 Hammond UP645 NIBCO T-113-LF
Gate	2-1/2" or larger	NIBCO F-619-RW
Gate-Underground	3" and larger	Mueller A-2362 NIBCO F-619-RW
Check-Swing	2" and smaller	Milwaukee UP509 Hammond UP943 NIBCO 413Y-LF
Check-Spring	2" and smaller	Milwaukee UP548T NIBCO 480Y-LF
Check-Swing	2 1/2" and larger	Apollo 61YLF NIBCO F-910-B-LF
Check-Spring	2-1/2" and larger	NIBCO F-938--33
Gas Cock (ball)	2" and smaller	Milwaukee BA475B Hammond 8901 NIBCO FP600
Gas Cock (plug)	1/2" to 4"	Homestead 611/612 Walworth 1796/1797 (with wrench)

- B. All pump discharges shall have a check valve placed minimum 5 pipe diameter from the pump.
 - 1. NIBCO W920W or F910B
 - 2. Acceptable equal.
- C. All below grade ball valves shall have stainless steel handles.

2.5 HANGERS AND SUPPORTS

- A. In general, all pipe hangers and supports shall conform to the following except where special pipe hangers and supports are detailed on the Drawings. In all cases hanger and support details on the Drawings shall take precedent over the following:

Items	TOLCO	Anvil
Pipe Hanger	1; 2; 200	260
Side Beam Clamp for Wood Joist	58	207
Beam Coupling for Steel Beams	65	92
Rod Coupling for Connection to "Hilti"	70	135
Inserts in Concrete Decks	107;109A;109AF	N/A
Trapeze Hangers	Tolstruct A12	AS200
Pipe Clamp	Tolco Cush Clamp	AS004OD – AS098OD

- B. Similar items by Anvil International, Erico-Caddy, or TOLCO/B-Line will be acceptable.
- C. Hanger Rods shall conform to the following table:

Tube/Pipe Size	Rod Diameter
1/2" to 4"	3/8"
5" to 8"	1/2"
10" to 12"	5/8"

- D. Trapeze hangers may be used where parallel runs of pipe occur. All rods on trapeze hangers shall be 1/2" minimum size.
- E. Hanger Support Spacing shall be as follows unless shown otherwise on the Drawings:
 - 1. Horizontal:
 - a. Cast Iron: Every other joint unless over 4 feet, then at every joint.
 - b. Copper: Every 6 feet for 1-1/2 inch and smaller, and 10 feet for 2 inch and larger.
 - c. Steel, Gas: Every 6 feet for 1/2 inch, 8 feet for 3/4 inch and 1 inch, and 10 feet for 1-1/4 inch and larger.
 - d. Schedule 40 PVC or ABS DWV: Every 4 feet for all sizes. Provide for expansions every 30 feet.
 - 2. Vertical:
 - a. Cast Iron: Base and every floor not to exceed 15 feet.
 - b. Copper: Every floor not to exceed 10 feet.

- c. Steel, Gas: Same as horizontal spacing except 1-1/4" and larger at every floor.
 - d. Schedule 40 PVC or ABS DWV: Base and every floor with mid-floor guides. Provide for expansion every 30 feet.
- F. Refer to the plumbing code for materials not listed above.
- G. At all points where insulated pipe contacts a hanger or support, the point of contact shall be protected by a metal insulation pipe shield #B3153 as manufactured by B-Line. Equivalent pipe protectors will be considered provided the substitute item meets the same standard of quality and performance as the specified item.
- H. Seismic restraint devices
 - 1. Available Manufacturers:
 - a. Anvil/Badger
 - b. Mason Industries
 - c. B-Line Tolco Division of Eaton
 - 2. Seismic hanger system design shall meet the requirements of IBC, the 2022 CBC and ASCE 7-16.

2.6 WALL AND FLOOR PENETRATIONS

- A. Fire walls and floors:
 - 1. Wall and floor penetrations shall be protected with a U.L. approved fire rated system. The system shall be per the Drawing Details, or other manufacturer's installation instructions.
 - 2. Fire stopping materials by Hilti, Metacaulk, or 3M are considered equal. The material shall be the same as called out for in the U.L. approved system.
- B. Poured concrete walls and floors.
 - 1. Pipes penetrating poured concrete walls and floors shall be protected by providing the following:
 - a. A Schedule 40 PVC sleeve one (1) size larger than the pipe or one quarter (1/4) inch of foam material wrapped around and secured to the pipe or packed and caulked with mineral wool.
 - b. Protection shall end flush with the wall or floor surface.
- C. All walls and floors:
 - 1. Piping passing through walls and floors exposed to view shall be provided with chrome plated split-ring escutcheon plates in finished areas. Brass or galvanized escutcheon plates may be used elsewhere.

2.7 FLASHING

- A. All flashing shall be 4 lb. sheet lead and all vents penetrating the roof shall be flashed and counter-flashed. Stoneman Co. roof flashing assembly with 10" skirt or equal may be used.

- B. The flashing for vents penetrating a metal roof shall have a corrosion resistant aluminum base compatible with the roofing system. A rubber type flashing by "Tech Specialties" shall be installed between the flashing and pipe.
- C. For single ply roofing, provide flashing per roofing manufacturer recommendations or installation instructions.

2.8 VALVE BOXES

- A. Brooks Products Inc., Christy Co., or equal with the word "Water" or "Gas" cast in cover as applicable.

2.9 CLEANOUTS

- A. Provide cleanouts per Drawings and details on Drawings. Cleanouts as manufactured by J. R. Smith, Mifab, Wade, or Zurn are approved equals.
- B. Cleanout tops to be installed with tamper-proof screws.

2.10 FLOOR DRAINS AND FLOOR SINKS

- A. Provide drains as specified on the Plumbing Schedule. However, drains as manufactured by Watts, J.R. Smith, Mifab, Wade, or Zurn will be acceptable provided they are equal.
- B. Floor sinks by Watts, J.R. Smith, Mifab, Wade, Zurn, or Commercial Enameling are acceptable provided they are equal.

2.11 AUTOMATIC ELECTRIC TRAP PRIMERS

- A. Provide Precision Plumbing Products, J.R. Smith, Mifab or Sloan as specified on the Drawings. Install per manufacturer's instructions.

2.12 PLUMBING FIXTURES

- A. Fixture locations, quantities, types, sizes and connections shall be as shown on both the Plumbing and Architectural Drawings. If a conflict in fixture location is noted between the Plumbing and Architectural Drawings, the Architectural Drawings shall take precedence.
- B. Fixtures shall be thoroughly protected against damage to the chrome plate or enamel, by chipping, scratching or other damage during the entire period of construction. Roof drains, floor sinks and drains, toilet and sink drains, plumbing vents, and all other similar fixtures shall be covered to prevent trash from entering the pipes until final installation of grates, domes, fixtures or other protective devices.
- C. Provide fixtures as specified in the Plumbing Schedule. American Standard, Crane, Kohler, or Just are acceptable substitutes as equal if approved by Engineer.
- D. Fixture carrier numbers listed are as specified on the Plumbing Schedule; however, carriers as manufactured by J.R. Smith, Mifab, Wade, or Zurn, are acceptable provided they are equal.

2.13 CONNECTORS

- A. Provide Brass Craft "Speedway" or equal heavy pattern iron pipe size brass stops, rigid or flexible supplies and chrome plated brass "P" traps. Stops in

"Public" areas to have screwdriver slots and those in "Private" areas to have all cross handles.

- B. Provide Brass Craft or equal flexible stainless steel braided water supplies to appliances. They may also be used to fixtures as an option to rigid supplies. Aquaflo is an acceptable substitute.
- C. Provide Brass Craft flexible or equal, stainless steel gas appliance connectors. Dormont is an acceptable substitute. Diameter of connector to be as recommended by manufacturer based on connector length and rated capacity of equipment.

2.14 PRESSURE GAGES AND THERMOMETERS

- A. Provide Marsh Quality gages or equal with 3-1/2" dial, gage cock, in type required. For pump suction, provide compound type.
- B. Provide Trerice 7" BX or 3" Bimetal Dial series thermometers or equal, straight, angle, or oblique as required, equipped with separable sockets and well. Provide extension necks as required on insulated line.
- C. Arrange gages and thermometers for easy reading.

2.15 WATER HEATERS

- A. Provide water heaters as specified in Plumbing Schedule or approved equal of size, capacity, recovery, and KW/BTUH input. American, A.O. Smith and State are considered equal. Heater shall be A.G.A. or U.L. listed.
 - 1. Gas heaters shall be provided with an A.G.A. approved 100% safety shut-off.
 - 2. Provide approved flexible copper supplies for the water heater water connections.
 - 3. Instantaneous tankless water heaters shall be with water flow activated switch to energize the electrical/gas power source, a safety high water temperature limit, and all standard factory trim.

2.16 PRESSURE-TEMPERATURE RELIEF VALVE

- A. Pressure-temperature relief valve shall be Wilkins TP220, or TP3000 Series or equal.

2.17 EXPANSION TANK

- A. Expansion tank shall be Wilkins WXT series as specified on the Drawings or approved equal in size and capacity. Amtrol and Watts expansion tanks are considered equal.

2.18 PIPE INSULATION

- A. Article includes insulating the following plumbing piping services:
 - 1. Domestic hot-water piping.
 - 2. Domestic hot-water return piping, including the piping between where the return piping intercepts the domestic cold water supply piping and the water heater.
 - 3. Domestic cold-water piping where the following conditions occur:

- a. Last 8 feet of piping to the water heater including piping between a storage tank and a heat trap, for a nonrecirculating storage system.
 - b. Piping in unheated areas of the building.
 - c. Piping exposed outside the building.
- B. Domestic cold-water piping in unheated areas of the building and where exposed outside the building shall be insulated with 1" insulation. Where insulation is required in other areas the insulation shall conform to the requirements for domestic hot water supply and return piping.
- C. Insulation material shall meet requirements of flame spread not to exceed 25 and smoke developed not to exceed 50 as tested by Procedure ASTM-E-84, NFPA 225 or UL 723.
- D. Domestic hot water supply and return piping shall be insulated with Owens-Corning Fiberglass heavy density pipe insulation 25 ASJ/SSL-II (All Service Jacket/Double/ Self-Sealing Lap). Insulation shall have a k-factor of 0.24 @ 100 degrees F mean temperature, an embossed vapor barrier laminated and pressure sealing lap adhesive. All lap and butt strips shall have integral pressure-sensitive strips and shall be applied in strict accordance with manufacturer's instructions. Insulation thickness shall be as follows:

PIPE INSULATION THICKNESS							
FLUID OPERATING TEMPERATURE RANGE °F	INSULATION CONDUCTIVITY			NOMINAL PIPE DIAMETER IN INCHES			
	k FACTOR	MEAN RATING TEMPERATURE °F		< 1	1 to < 1.5	1.5 to < 4	4 to < 8
Service Water Heating Systems				Minimum Pipe Insulation Require (Thickness in inches or R-value)			
141-200	.25-.29	125	Inches	1.5	1.5	2.0	2.0
			R-Value	R-11.5	R-11	R-14	R-11
105-140	.22-.28	100	Inches	1.0	1.5	1.5	1.5
			R-Value	R-7.7	R-12.5	R-11	R-9

- E. Insulation materials not meeting the specified conductivity range shall be submitted for approval. Submittal shall clearly identify compliance with this article.

PART 3 – EXECUTION

3.1 GENERAL CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed. Conditions detrimental to timely and proper completion of the Work shall be brought to the attention of the Architect before the installation of materials. Do not proceed until unsatisfactory conditions are corrected. Incorrectly installed materials requiring changes will be at Contractor's expense.

- B. All plumbing fixtures, appliances, and appurtenances furnished with manufacturer's installation instructions shall be installed per those instructions.

3.2 PLUMBING SYSTEM LAYOUT

- A. Lay out the plumbing system in careful coordination with the Drawings. Determine proper elevations for all components of the system and use only the minimum number of bends to produce a satisfactorily functioning system.
- B. Follow the general layout shown on the Drawings in all cases except where other Work may interfere.
- C. Lay out pipes to fall within partitions, walls, or roof cavities, and to not require furring other than as shown on the Drawings.

3.3 PIPING INSTALLATION

- A. Pipe sizes as shown on drawings are Nominal Pipe Size (NPS) or Iron Pipe Size (IPS). Drawings and fixture schedule indicate pipe sizing per the 2022 CPC and Standard Engineering Practice. Pipe sizes shall be maintained to fixtures, appliances and equipment. Approved reducing fittings shall be installed at all points of connections.
- B. Install piping generally square with building, free of traps or air pockets, and true to line and grade. Keep all piping tight to the building structure, unless pipe slope is required. Do not install piping in any locations where, in the Architect's opinion, it will interfere with the use of the building or create a safety hazard. Where space is inadequate, notify the Architect in time to avoid unnecessary Work. Install all exposed piping as high as possible without interfering with other trades.
- C. Make changes in direction with manufactured fittings; use long radius elbows. Street elbows, bushings, close nipples and bending of pipe or tubing will not be allowed.
- D. Provide "P" traps at sanitary sewer drainage devices without integral traps.
- E. All natural gas piping under structures or concrete slabs will be installed in a protective vent sleeve. Sleeves under a building will be vented to outside the building per detail on Plans. Sleeves under concrete slabs will extend a minimum of 1 foot beyond the slab. All sleeves will be sloped 1/8" per foot up toward the vented end. The vent end of sleeves under slabs will terminate under a landscaped or asphalted area.
- F. Gas piping shall be tapped off the top or side of pipe and ends of mains shall be provided with dirt legs.
- G. Underground plastic pipe will horizontally transition to metal pipe 5 feet before the above ground riser. Install plastic pipe with a minimum of 36" of cover when located under areas of possible vehicle traffic. Approved metallic pipe must be used if the minimum depth is not met. A tracer wire, terminating at each end at an exposed location, will be installed with all underground plastic pipe. Gas piping will also have a continuous tape marked "Gas" laid 6" above it.
 - 1. Piping may terminate a maximum of one foot above ground when encased in a listed metallic transition riser.

- H. Use friction wrenches when installing brass, polished, or soft metal piping, and when installing piping exposed in finished areas. Replace piping showing wrench marks.
- I. Attach escutcheon plates to pipes with set screws or spring clamps with concealed hinges. Continue insulation through escutcheon plates.
- J. General:
 - 1. Proceed as rapidly as the building construction will permit.
 - 2. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.
 - 3. Cut pipe accurately, and work into place without springing or forcing, properly clearing windows, doors, and other openings. Excessive cutting or other weakening of the building will not be permitted.
 - 4. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
 - 5. Provide sufficient swing joints, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the Drawings.
 - 6. Support piping independently at pumps, coils, tanks, and similar locations, so that weight of pipe will not be supported by the equipment. Support the equipment independently from the pipe.
 - 7. Pipe the drains from mechanical equipment, drip pans, relief valves, air vents and similar locations, to an open sight drain, floor drain, or other acceptable discharge point, and terminate with an air break or air gap per the 2022 CPC.
 - 8. Securely bolt all equipment, isolators, hangers, and similar items in place.

3.4 PIPE SUPPORT INSTALLATION

- A. Support pipes from structure with assemblies specified. Provide auxiliary members, anchors, guides, and sway braces necessary to maintain pipe alignment and prevent excessive movement or strain on piping system or components; allow for expansion and contraction of piping. Provide at least one hanger for each branch. Do not use powder driven fasteners, wire, perforated tape, nails, wood blocking, or other makeshift devices to support pipe.
- B. Attach supports to structure with bolts, screws or concrete anchors, per support manufacturer's requirements.

3.5 JOINTS AND CONNECTIONS

- A. Cut pipe shall be reamed to full inside diameter of pipe. Cut threads straight and true. Insure all filings have been removed from inside of the pipe. Apply liquid Teflon to male pipe threads and not inside fittings. Use graphite on cleanout plug threads.
- B. Joints in cast iron "No-Hub" soil/waste pipe and fittings shall be made up with neoprene gaskets and stainless steel bands conforming to CISPI 310, torque to the manufacturer's specification with an approved torque wrench.

- C. Joints in copper tube shall be made with 95-5 tin-antimony or lead-free solder, applied in strict accordance with the manufacturer's directions.
- D. Dissimilar metals shall be isolated with dielectric couplings, "EPCO" or approved equal. Provide access panels at all hidden couplings.
- E. All plastic pipe shall be joined in accordance with the manufacturer's recommendations for their pipe and IAPMO Installation Standard per the 2022 CPC.
- F. Press Connections: Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.
- G. Pipe Protection: Provide protection against abrasion where copper tubing is in contact with other building members by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
- H. Penetration Protection: Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation, or by installing through an appropriately sized sleeve. Penetrations of fire resistance rated assemblies shall maintain the rating of the assembly.

3.5 SANITARY SEWER, VENT AND INDIRECT WASTE SYSTEM INSTALLATION

- A. Install horizontal drainage piping at a minimum 2%, condensate 1%, slope unless otherwise noted. Where this is impractical notify the Architect before installing the pipes.
- B. Install vent piping to drain back into the sewer system.
- C. Provide cleanouts where shown on Drawings and where required by governmental agencies having jurisdiction.
- D. All cleanouts to grade shall be firmly secured by means of a concrete block 20" square by 5" thick, and shall be flush with finished grade, unless otherwise noted on the plans.
- E. Provide automatic trap primers as specified at floor sinks and drains as indicated on Drawings or where required by governmental agencies having jurisdiction. Provide access panels for all hidden mechanical trap primers.

3.6 VALVE INSTALLATION

- A. Provide valves in the water, air, and gas systems. Locate and arrange so as to give a complete regulation of apparatus, equipment, and fixtures.
- B. Provide valves in at least the following locations:
 - 1. In branches and/or headers of water piping serving a group of fixtures.
 - 2. On both sides of apparatus and equipment.
 - 3. For shutoff of risers and branch mains.
 - 4. For flushing and sterilizing the system.
 - 5. Where shown on the Drawings.

- C. Locate valves for easy accessibility and maintenance. Provide access panels for all hidden valves.
 - D. Unions shall be installed downstream of all screwed valves.
- A. All gas pressure regulating valves shall be vented to the atmosphere.
- 3.7 CLEANOUTS:
 - A. Horizontal drainage pipe shall be provided with a cleanout at its upper terminal, and each run of piping, that is more than 100 feet in total developed length, shall be provided with a cleanout for each 100 feet, or fraction thereof, in length of such piping. An additional cleanout shall be provided in a drainage line for each aggregate horizontal change in direction exceeding 135 degrees. A cleanout shall be installed above the fixture connection fitting, serving each urinal, regardless if the location of the urinal in the building.
 - B. Exceptions – See 2022 CPC 707.4
- 3.8 PLUMBING FIXTURE INSTALLATION
 - A. Connect plumbing services to fixtures as shown on Drawings and as specified.
 - B. Install compression stops and flexible supplies per fixture manufacturer's recommendation or as high as possible on wall directly below fixtures.
 - C. Install fixtures at right angles to, and tightly against, building surfaces, and in proper alignment. Fill gaps between fixtures and building surfaces with white grout. Mounting heights and locations shall be as shown on the Drawings, or, if not shown, as directed by the Architect.
- 3.9 INSULATION INSTALLATION
 - A. Clean and dry surfaces prior to application of insulation or adhesives.
 - B. Insulate piping, fittings, valves, and strainers. Leave unions exposed. Where insulation terminates, bevel ends of insulation and continue jacket over insulation and secure to pipe. Do not interrupt insulation at hangers, supports, clamps, or penetrations through structure. Fittings shall be finished with "Zeston" or approved equal fitting closures. If fitting closures not available, use 8 oz. canvas dipped in "Seal-Fas".
 - C. Attach longitudinal jacket laps and butt strips with factory applied pressure sensitive adhesive. On concealed piping only, outward clinching coated staples at two inch spacing may be used. Cover elbows with one piece polyvinyl chloride covers. Secure with tack fasteners. Tape ends of covers with matching tape on exposed piping. Seal off all cut ends with canvas and Benjamin Foster 30-36.
 - D. Install closed cell polyethylene foam per manufacturers instructions.
- 3.10 TESTING AND ADJUSTING
 - A. Provide personnel and equipment, and arrange for and pay the costs of, all required tests and inspections required by governmental agencies having jurisdiction. See Section 23 00 13 for test requirements.
 - B. Where tests show materials or workmanship to be deficient, replace or repair as necessary, and repeat the tests until the specified standards are achieved.
 - C. Adjust the system to optimum standards of operation.
- 3.11 CLEANING (FOR POTABLE WATER SYSTEMS.)

- A. Disinfection: The hot and cold water distribution system shall be disinfected prior to being placed in service. The system shall be disinfected within 3 weeks of occupancy in accordance with AWWA C651 or the following requirements:
1. The piping system shall be flushed with potable water until discolored water does not appear at any of the outlets.
 2. The system shall be filled with a water chlorine solution containing at least 50 parts per million of chlorine. The system shall be valved off and allowed to stand for 24 hours. Or, the system shall be filled with a water chlorine solution containing at least 200 parts per million of chlorine. The system shall be valved off and allowed to stand for 3 hours.
 - a. To prevent reduced service life of system components, disinfection solutions should not stand in the system longer than 24 hours.
 3. Following the standing time, the system shall be flushed with water until the chlorine is purged from the system.
 4. Provide bacteriological sampling and analysis results to the Engineer for review.

3.12 WARRANTY

- A. The contractor shall warranty all of the systems for proper operation installed by the contractor for not less than one calendar year from date of project completion. This completion date shall be set by the Architect or owner.

END OF SECTION

SECTION 23 00 00

HEATING, VENTILATION, AND AIR CONDITIONING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 01 91 13 General Commissioning Requirements.
3. Where the requirements of the Section exceed those in other Contract Documents, Contractor shall comply with the requirements of this Section.

B. Codes and Regulations:

1. In addition to complying with the specified requirements, comply with pertinent regulations of the Authority Having Jurisdiction. All work must comply with the version of the code that was in effect at the time of the initial permit application date.
 - a. CALGreen – California Green Building Standards Code
 - b. CBC – California Building Code
 - c. CEBC – California Existing Building Code
 - d. CEC – California Electrical Code
 - e. CEnC – California Energy Code
 - f. CFC – California Fire Code
 - g. CMC – California Mechanical Code
 - h. CPC – California Plumbing Code
 - i. CRC – California Residential Code
 - j. DPH – Department of Public Health
 - k. DWR – Department of Water Resources
 - l. DSA – Division of the State Architect
 - m. HCD – Housing and Community Development
 - n. NFPA – National Fire Protection Association
 - o. SFM – Office of the State Fire Marshal
 - p. Reach Codes that have been adopted by the Authority Having Jurisdiction
 - q. Local Building Department
 - r. Local Fire Marshall

2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirements will govern when so directed by the Architect.
- C. Included: Work includes, but is not limited to, the following.
1. The Work covered by this Specification shall include furnishing labor, material, equipment, and services to construct, install and place in operation, the complete Heating, Ventilating and Air Conditioning Systems to the extent as indicated, and as shown on the Drawings and specified herein. The Work covered under this Section shall hereinafter be referred to as the Mechanical System.
 - a. Centrifugal Exhaust Fans
 - b. Duct systems complete with supports, dampers, grilles, registers, diffusers and louvers.
 1. Exhaust Air
 2. Combustion Air
 - c. Duct, Pipe and Equipment Insulation
 - d. Low Voltage Controls
 - e. Vibration Isolators
- D. Work Not Included In This Section:
1. Blocking, framing and wood supports required for the purpose of accommodating the Mechanical System unless specifically called for under this Division. The contractor is responsible for the correct location of such items and shall bear the expenses covering their omission or improper location.
 2. Electrical connections to motors, electric starters, disconnect and over-current protective devices, unless specifically called for by this Section, or unless the equipment is furnished as an integral part of the Mechanical System Equipment, as hereinafter specified, or noted on the Drawings.
 3. Line voltage electrical wiring and conduit, except where specifically called for on the Drawings or hereinafter in this Section.
 4. Painting, except when supplied as factory finish, or specifically called for in this Section or on Drawings.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the Work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether

such materials and associated labor are called for elsewhere in these Contract Documents.

1.3 SUBMITTALS

- A. Comply with pertinent provisions of Architectural Section.
- B. Product data: Within 35 calendar days after the Contractor has received the Notice to Proceed, submit the following to the Architect for approval prior to acquisition:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications, cut sheets, and other data needed to prove compliance with the specified requirements. All pieces of equipment shall be clearly identified on corresponding manufacturer's literature being submitted. All information for each item shall be correlated.
 - 3. Shop Drawings or other data as required to indicate method of installing and attaching equipment, ductwork and piping except where such details are fully shown on the Drawings.
 - 4. Submittals for the entire Project shall be submitted at the same time. Incomplete or noncompliant submittals may be rejected.
 - 5. Submittals shall be provided in pdf format.

1.4 DESIGN CHANGES CAUSED BY PRODUCT SUBSTITUTIONS

- A. If the heating and/or air conditioning equipment is substituted with a different brand or model than that specified on the Drawings the Authority Having Jurisdiction may require the energy compliance calculations to be updated. The contractor shall be responsible for all cost related to updating the calculations. If the substituted equipment does not comply the contractor shall be responsible for providing equipment that meets or exceeds the performance of the specified equipment at no additional cost to the Owner.
- B. Contractor shall pay costs of design and installation for changes resulting from substitution of alternate products.
- C. Acceptance of alternate products by Architect does not change this requirement.

1.5 PRODUCT HANDLING

- A. Comply with pertinent provisions of Architectural Sections.

PART 2 - PRODUCTS

2.1 HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

- A. Heating, Ventilating, and Air Conditioning Equipment: Equipment shall be as specified on the Drawings. All other equipment shall be pre-approved by the Mechanical Engineer.
- B. It shall be the responsibility of the Contractor to see that any substituted equipment performs similarly to that which is specified and fits in the same area as specified. Cost of any additional Work caused by the substitution of equipment shall be borne by the Contractor.

2.2 RECTANGULAR SHEET METAL DUCTWORK

- A. Rectangular supply, return, outside air and exhaust ducts, single leaf dampers and plenums shall be fabricated from prime grade galvanized steel sheets of lock form quality and shall be constructed in accordance with appropriate tables of the latest ASHRAE "Guide and Data Book" and SMACNA "HVAC Duct Construction Standards" handbook and Chapter 6 of the 2022 CMC.
- B. Transverse Duct Joints shall be made with The Ductmate System. When using The Ductmate System, construction of the duct such as gage, reinforcing, etc. shall be as indicated in the latest addition of the applicable SMACNA standards. With proper data, an equal may be submitted, providing the corners have a downset and corner clips to insure airtight integrity. Testing must be done by a nationally recognized testing laboratory. The standard Ductmate 35 System joint is the equivalent of a SMACNA "J" connection. The Ductmate 25 System joint is the equivalent of a SMACNA "F" connection. The installation of the Ductmate System shall be in accordance with the latest manufacturer's printed Assembly and Installation Instructions.
- C. Each duct or plenum shall be diagonally cross-broken for rigidity.
- D. Duct bends, fittings, transitions, etc. shall be fabricated in accordance with Fabrication Standards as shown on the Drawings or in accordance with latest SMACNA "HVAC Duct Construction Standards" where not shown on Drawings.
- E. Support ducts to joists or similar structural members. Except where indicated otherwise, ducts with a side of 24" or more shall be supported on Ductmate trapeze duct hangers consisting of 2" high x 1-1/2" wide x 18" gauge channel and 3/8" diameter hanger rods hung from support brackets bolted to structural members. See also Special Fabrications as shown on the Drawings. Duct supports shall be eight (8) feet maximum on center.
- F. At branch ducts, provide manually operated dampers of the type and arrangement shown on the Drawings, two gages heavier than the duct (if single leaf type) in which installed, and equipped with locking quadrants and closed end bearings.
- G. Sizes shown on Drawings are net inside dimensions. Enlarge duct to accommodate lining.

2.3 ROUND DUCTWORK AND FITTINGS

- A. 2-10" w.g. round duct through 61" in diameter shall be United Sheet Metal spiral lockseam unseal duct, or approved equal, manufactured from galvanized steel meeting the ASTM A-527-71 in the following gages:

Diameter	Metal Thickness
3-13"	26 ga.

- B. Round duct shall be new and exclusively obtained for this project. Each piece shall be in 20' lengths. Ducts shall be cut to length required with joints only at fitting locations, except on duct runs longer than 20 feet.
- C. Spiral duct and fitting connections, 15" diameter and larger shall be Ductmate Spiralmate round duct connectors. The connector system shall consist of two

mating round duct connector flanges roll-formed from hot dipped galvanized steel with an integral sealant and closure ring roll-formed from hot dipped galvanized steel.

- D. Fittings shall be United Sheet Metal galvanized fittings in the following gauges:

Diameter	Metal Thickness
3-13"	24 ga.

- E. Spiral duct fittings must be manufactured as separated fittings and shall not be saddle taps, stubs or tap-in fittings tapped into spiral duct, nor may they be dove-tailed tap-ins into pipe or fittings.
- F. Reducers shall occur after a branch tap occurs on the main portion of the fitting. Divided-flow fittings shall be used unless shown otherwise on the Drawings.
- G. Joints on ducts and fittings shall be covered and sealed with 4" wide, 6 oz. canvas saturated with Arabol lagging adhesive, or Hardcast DT tape in conjunction with Hardcast FTA-20, non flammable, non-toxic adhesive, or GlenKote duct sealer or other approved mastic type sealer. Duct tape will not be allowed. Where exposed to weather, paint lagging strips with two coats of silver enamel paint.
- H. All ductwork shall be constructed and supported in accordance with appropriate tables of the latest SMACNA "HVAC Duct Construction Standards" handbook and Chapter 6 of the 2022 CMC. Duct gauges to be in accordance with this section.

2.4 FLUE VENT PIPE AND FITTINGS

- A. Type B double wall vent pipe with UL label shall be used for gas burning appliances, except gas wall furnaces and gas appliances with power burners. Install per manufacturer's recommendations.
- B. Boilers: FasNSeal by M&G DuraVent Inc. AL29-4C stainless steel, double wall, gasketed installed per boiler and flue manufactures recommendations.
- C. For gas fired wall furnaces Type BW double wall vent pipe shall be used and installed per latest C.M.C. and manufacturers recommendations.
- D. For condensing equipment: IPEX System 1738 pipe, fittings, terminations, and cement. All materials shall be third party listed to UL 1738. Materials shall comply with ASTM D1784 and have a cell class of 12454 or 23447. All materials that make up the venting system shall be by the same manufacturer and shall be installed per the manufacturers installation instructions.
- E. Flues or vents shall terminate above the roof with flashing and a listed vent cap installed in accordance with its listing and the manufacturer's instructions. Flues or vents shall terminate as required per current CMC.
- F. Vent cap shall be of the same manufacturer as the flue pipe.

2.5 FLEXIBLE CONNECTIONS

- A. Provide fireproof, insulated, non-porous, flexible connections between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts,

securely fasten flexible connections by zinc coated steel clinch-type drawbands. Flexible connections shall be DuroDyne "Insulfab" or "Insulflex" or approved equal.

- B. Provide a duct support next to each flex connector to prevent any strain on connection.

2.6 ELECTRICAL EQUIPMENT

- A. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for motor control specified. Mount starter adjacent to equipment. See electrical drawing. Maintain minimum of 3' clearance to front of device.
- B. Motor Starters: Shall be NEMA I or III as appropriate, general purpose, weather-resistant, with watertight enclosure where required.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 COORDINATION

- A. Coordinate as required with other trades to assure proper and adequate provision in the Work of those trades for interface with the Work of this Section.

3.3 PREPARATION

- A. Holes in concrete:
 - 1. Provide sleeves, accurately dimensioned and shaped to permit passage of items of this Section.
 - 2. Deliver such sleeves, with accurate setting drawings and setting information, to the trades providing the surfaces through which such items must penetrate, and in a timely manner to assure inclusion in the Work.
- B. Flashing:
 - 1. Where items of this Section penetrate the roof, outer walls, or waterproofing of any kind, provide under this Section base flashing and counterflashing required at such penetration.
 - 2. Provide on each pipe passing through the roof a 4 pound seamless lead flashing and counterflashing assembly.

3.4 GENERAL INSTALLATION REQUIREMENTS

- A. Conceal piping, ductwork, and equipment in spaces provided unless specifically shown otherwise. If spaces are inadequate, notify Architect in time to avoid unnecessary Work. Do not cut or notch structural members without specific approval of the Architect.

- B. Follow manufacturer's instructions on items not specifically covered in drawings and specifications. Report discrepancies to Architect for clarification before starting Work.

3.5 EQUIPMENT INTERFACE

- A. Provide required shut off valves, unions, and final connections of piping to the Work of this Section.
- B. For electrically operated equipment, verify the electrical characteristics actually available for the Work of this Section and provide equipment meeting those characteristics.

3.6 PAINTING

- A. Paint inside of air outlets and connecting plenums with one coat of flat black paint, or provide all such items factory prepainted.
- B. For roof-mounted equipment, provide factory pre-finish on exposed surfaces.
- C. Touch-up scratches and abrasions to be invisible to the unaided eye from a distance of 5 feet.

3.7 INSTALLATION OF DUCTWORK

- A. Ductwork shall be delivered to the Project site with surfaces clean and free of loose dirt and rust. Special care shall be exercised by the Contractor to store the duct in a clean area to prevent the accumulation of dirt prior to installation. Fabricated or partially fabricated duct sections shall not be stored in open fields or on dirt areas surrounding the construction site. Paved areas may be used, if available, provided adequate protection is provided to prevent the accumulation of dirt on duct surfaces. If possible, the Contractor should arrange to deliver duct to the project site and store on the floor of the area in which it is to be installed.
- B. Before installation of ductwork, the Contractor shall inspect each section of duct and wipe internal surfaces clean. At the end of each Work period, or when ends of duct are left installed for future extension, the open ends shall be tightly closed off with a plastic sheet and taped securely to the open end of the duct.
- C. Construct and install sheet metal in accordance with latest SMACNA recommendations. Provide variations in duct size and additional duct fittings as required and approved by the Architect at no extra cost to the owner.
- D. The throat radius of bends shall be 1-1/2 times the width of the duct. Provide turning vanes in any mitered turn greater than 45 degrees.
- E. Transition slopes shall be no less than one to five where space permits.
- F. Abrupt offsets in the duct system greater than 30 degrees will not be allowed.

3.8 CONTROL DEVICE IDENTIFICATION LABELS

- A. Thermostats and Exhaust fan switches shall have labels mounted on or just above the control device labeled with the equipment being controlled. As an example, for a exhaust fan controlled by a switch the label would read "EXHAUST FAN # 1" or if a thermostat the label would read "AC-1".

1. Labels shall be 2" x 1" x 1/8" thick Formica/plastic engraving stock beveled on both sides and with two 3/16" diameter holes near the top uppermost tag corners.
2. Labels shall be white with 3/8" high red engraved letters.
3. Labels shall be attached to the equipment with adhesive.

3.9 WARRANTY

- A. The contractor shall warranty all of the systems for proper operation installed by the contractor for not less than one calendar year from date of project completion. This completion date shall be set by the Architect or owner.

3.10 MECHANICAL SYSTEM START-UP RESPONSIBILITY

- A. Start up Mechanical Systems, and perform any such Work as may be required to adjust the systems to meet the requirements of the Contract Documents. Air distribution balancing shall be performed in accordance with Article "MECHANICAL SYSTEMS BALANCING".
- B. Install new clean specified filters in equipment containing filters immediately prior to owner occupancy. Contractor to bear all costs for this work.

3.11 MECHANICAL SYSTEMS BALANCING

- A. Testing and air balancing shall be performed by an independent balancing company certified by Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB) or Testing, Adjusting, and Balancing Bureau (TABB). Testing and balancing shall be performed by a company other than the mechanical system installers/contractor. The name of the firm that the Contractor proposes to engage to perform this Work of balancing the system shall be submitted to the Engineer for approval prior to commencing the Work.
- B. After Systems have been tested as outlined, air and water flow rates shall be balanced, and control devices adjusted. Balance and testing shall not begin until systems have been completed and are in full working order. Upon completion of the balancing operation and prior to final acceptance of the systems, the balancing firm shall submit a report, with six (6) copies, certifying to the proper performance of the system for approval by the Mechanical Engineer.
 1. The following information shall be included in the Air Side Report:
 - a. Fan speeds.
 - b. Motor current readings and voltage readings.
 - c. Air quantities in CFM at supply, return, exhaust terminals, and outside air intakes, both at design value and actual measured value. Test and adjust each terminal to within +10% of design requirements.
 - d. Air velocities in FPM at supply, return, and exhaust terminals at design value and actual measured value.
 - e. Positive static pressure, negative and total pressures and total air quantities for each fan system.

f. Equipment nameplate data.

END OF SECTION

SECTION 23 00 13
GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Related Documents:
 - 1. The other Contract Documents complement the requirements of this Section.
 - 2. Division 1 - General Requirements applies to the Work of this Section.
 - 3. Where requirements of this Section exceed those in other Contract Documents, Contractor shall comply with the requirements of this Section.
- B. Codes and Regulations:
 - 1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
- C. Included: Work includes, but is not limited to the following:
 - 1. Heating, Ventilating, Air Conditioning and System Balancing
 - 2. Plumbing
 - 3. Fire Protection
 - 4. Carpentry and metal Work required for Work of this Section and not specifically shown under another Section. Openings in concrete or masonry construction shall be either core drilled or saw cut unless indicated otherwise on Drawings.
 - 5. Excavation and Backfill
 - 6. Coordination Drawings
- D. Related Work:
 - 1. Painting (Division 9)
 - 2. Cutting and Patching (Division 1)
 - 3. Low voltage electrical control (Division 16)

1.2 DEFINITIONS

- A. Furnish: Purchase and deliver to job site in new condition.
- B. Install: Receive and store at job site until required; place secure and connect; furnish required appurtenances.
- C. Provide: Furnish and install as defined above.
- D. Section: Refers to a Section of these Specifications.
- E. Standards: The issue in effect as of the date of the contract documents.

1.3 PROJECT RECORD DRAWINGS

- A. Comply with pertinent provisions of Architectural Sections (Division 1).

1.4 SERVICE INTERRUPTIONS

- A. When Work of this Section requires temporary shutdown of existing systems for connections, the shutdown shall be made only during pre-arranged time agreeable to the Owner.

1.5 CORRELATION, INTERPRETATION AND INTENT OF CONTRACT DOCUMENTS

- A. The Mechanical Drawings are, in general, made to scale and the Contractor may obtain approximate distances and dimensions by scaling the Plans. It is distinctly understood, however, that it is done entirely at the Contractor's responsibility. Refer to Architect's Plans and Specifications for construction details, which will affect the Work and equipment. Examine the Architectural, Civil, Structural, Mechanical, Electrical, Landscape, Irrigation, Data, Fire Protection and Plumbing Plans and Specifications to ensure that this work does not conflict with the above trades. Plumbing, Mechanical and Electrical Plans are diagrammatic and, therefore, do not necessarily represent the exact installation. However, pipe sizing for utility services and ductwork are calculated per their respective codes and Standard Engineering Practice and shall be installed as sized from point of origin to terminal point. It shall remain the Contractor's responsibility to submit Shop Drawings if he/she has any questions about the final arrangement. Nothing on these Plans or Specifications shall be construed to permit work not conforming to all applicable codes and regulations.

PART 2 - PRODUCTS

2.1 FLASHING

- A. Provide watertight flashing at all openings through exterior walls and roof. Refer to Architectural Drawings.

2.2 VIBRATION ISOLATION AND NOISE CONTROL

- A. All fans, heating and ventilating units, air conditioning units, blowers and similar equipment shall be securely mounted to and/or supported from the structure.
- B. Isolate all bare water piping from structural members or hangers with "Trisolators" or submitted and approved equal insulating sleeves. Install hangers on outside of insulated jacket on all insulated lines.

2.3 WEATHERPROOFING

- A. All equipment exposed to weather shall be protected by means of a suitable finish (i.e. paint). All fan cabinets, roof-mounted equipment, and ductwork shall be fabricated in such a manner to prevent leakage through seams and joints. Water rated, exterior hoods shall be provided over motors, belts, and other devices to insure against damage by water. At all locations where pipes and/or ducts penetrate exterior walls, or roofs, suitable rain tight flashing shall be provided.

2.4 PIPE WRAPPING

- A. All pipe, metal components, and joints buried in ground shall be primed and protected with 10-mil tape double wrapped or approved equal per IAPMO IS 13-2006. Before tape application, all bare pipe and fittings to be wrapped must be coated with pipe wrap primer. Stretch first layer of tape to conform to the surface while spirally half-lapping, apply a second layer, half-lapped and spiraled as the

first layer with spirals perpendicular to first wrapping. In lieu of tape wrap, heat shrinkable 10-mil minimum thick polyethylene sleeve may be used.

- B. When applying tape, use only enough pull to cause the tape to properly conform to the irregular surfaces of the item. The proper amount of pull is reached when the tape surface is smooth without any wrinkles. Continue tape 4" above grade. End overlaps should point down. Tape shall be applied per manufacturer's installation instructions.

2.5 ELECTRIC MOTORS AND ELECTRICAL DEVICES

- A. All Electric motor current characteristics are as shown in equipment schedules on drawings and as specified hereinafter in this Specification. The Contractor shall refer to the Electrical Plans and shall confirm all motor voltage, amperage and phase characteristics before processing submittals or ordering equipment. If any equipment is installed different from the supplied electrical power, it is the contractor's responsibility to correct equipment to the required electrical characteristics.
- B. All electrical devices of a type normally listed by Underwriters Laboratories, Inc. shall bear U.L. label of approval.
- C. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for motor control specified. Mount starter adjacent to equipment. See electrical drawing. Maintain minimum of 3' clearance to front of device.
- D. Motor Starters: Shall be NEMA I or III as appropriate, general purpose, weather-resistant, with watertight enclosure where required.

2.6 PAINTING AND FINISHING

- A. Provide the coating specified below unless otherwise specifically called for under Painting, Division 09900. Exclude non-ferrous items, stainless steel, items to be insulated, and factory-finished items. Conform to requirements of the Painting Section where requirements are not specified in this Section.
- B. All materials used, except as otherwise specified in carrying out the provisions of the contract, are to be Fuller-O'Brien manufacturer or approved equal. Numbers given below are Fuller-O'Brien Company designation unless noted otherwise.
 - 1. Primer coat for all exterior and interior materials: 1 Coat - Primer #66850
 - 2. Finish coats as listed below:

Exterior concrete and concrete block	2 Coats – Semi-Gloss #664XX
Interior concrete and concrete block	2 Coats – Semi-Gloss #214XX
Exterior metal	2 Coats – Semi-Gloss #664XX
Interior metal	2 Coats – Semi-Gloss #214XX
Exterior galvanized metal	2 Coats – Semi-Gloss #664XX
Exterior stucco	2 Coats – Flat #668XX
Interior of Grilles, Diffusers, and Registers	1 Coat – Flat (black) #31202

- 3. Furnish equipment with factory or field-applied prime coat and finish coat of enamel. Restore damaged finishes to match original.

PART 3 - EXECUTION

3.1 GENERAL EQUIPMENT INSTALLATION REQUIREMENTS

- A. Install equipment to provide neat appearance, required manufacturer's access, and required space to allow replacement or maintenance. Provide bases, supports, anchor bolts, and other items required to install equipment. Installation shall be level and braced per CBC.
- B. Equipment shall operate quietly and without objectionable vibration. Excessive vibration, other than from specified equipment operating at optimum conditions, shall be the Contractor's responsibility and shall be eliminated as directed by Architect.

3.2 COORDINATION OF WORK

- A. Coordinate Work of this Section with Work of other Sections to avoid conflicts. If required, provide shop drawings and submit to Architect for approval.
- B. Insure that Work of other Sections is suitable to accommodate Work of this Section.

3.3 ADEQUACY OF FURRING

- A. Conceal piping and ductwork in spaces provided unless specifically shown otherwise. If spaces are inadequate, notify Architect prior to ordering materials and fabrication of components.

3.4 PROTECTION AND CLEANING

- A. Protect equipment from dirt, moisture, and mechanical damage during construction. Restore or replace damaged equipment to original condition.
- B. Keep interior of piping and ductwork free of foreign material during construction. Flush piping systems with test medium specified under Piping Tests before installing equipment and appurtenances or making final connections.

3.5 CLOSING-IN OF UNINSPECTED WORK

- A. Do not conceal or cover Work before tests and observations are completed. Uncover Work prematurely closed in and repair resulting damage to all Work, if requested by Architect, Engineer, or Project Inspector.

3.6 DAMAGE

- A. Repair or replace items damaged by leaks or overflow from Work provided under this Section and for any damage to any part of the project site, for a period of 1 year after notice of completion date. This is in addition to and not a limitation of other rights the Owner may have against the contractor under the Contract Documents.

3.7 PAINTING AND FINISHING

- A. The contractor shall examine carefully all surfaces to be finished under the contract; and before beginning any of his work shall see that the work of other trades has been left or installed in a workmanlike condition to receive paint, or a particular finish.
- B. The contractor shall take the necessary steps to protect his work and the work of other contractors during the time his work is in process and the contractor shall

be responsible for any and all damage to the work or property of other contractors caused by his employees or by himself.

- C. Provide protective covers or drop cloths to protect floors, fixtures, and equipment. Exercise care to prevent paint being spattered on to surfaces which is not to be painted. Surfaces, from which such paint cannot be satisfactorily removed, shall be painted or repainted, as required to produce a finish satisfactory to the Architect.
- D. Cracks, holes, or imperfections in concrete or plaster are to be filled with patching plaster and smoothed off to match adjoining surfaces.
- E. All surfaces shall be in a proper condition to receive finish. Clean surfaces as necessary to receive paint. Remove all grease from metal surfaces before painting.
- F. Each coat of paint shall be applied at proper consistency and brushed evenly, free of brush marks, sags, runs, and with no evidence of poor workmanship. Color between coats of paint shall differ; (Color variations between coats should be enough to impair hiding.) Care shall be exercised to avoid lapping of paint on glass or hardware. Paint to be sharply cut to lines. Finished paint surfaces to be free from defects or blemishes.
- G. Exposed piping, ducts, and mechanical equipment (except for factory finished items) shall be painted. Exposed piping, except for identification banding, shall be painted to match surfaces adjacent. Each coat to be inspected when dry and subsequent coat not to be applied until approval received.
- H. Paint all surfaces visible through grille, diffuser and register faces, flat black.
- I. The contractor shall store all painting materials and equipment outside of the building. The receiving and moving of all paint materials and mixing shall be done outside of the building. Any other arrangements shall be made only with Architects approval.
- J. All necessary precautions shall be taken to prevent fire. Rags, waste, etc., soiled with paint or cleaning material, shall be removed from the premises at the end of each day's work.

3.8 MECHANICAL SYSTEM TESTING

- A. Furnish all test pumps, gauges, and equipment. Test all safety controls and devices.
- B. For air tests, install a calibrated test pressure gauge in the piping system to observe any loss in pressure. Calibrate the test pressure gauge with a dead weight tester within 15 days before use and certify by initial and date on a sticker applied to the dial face. Maintain the required test pressure for the time indicated. Brush joints with a soapy water solution to check for leaks if the required pressure cannot be maintained.
- C. After any test, repair all leaks found as directed and re-test as necessary until the system is proven tight.
- D. Before applying test pressure to any piping systems the Contractor shall be responsible for isolating all equipment e.g. control valves, regulators, relief

devices, tanks and any other line accessories, which would otherwise be damaged by the test pressure.

1. Soil, Waste, Vent, Roof, and Condensate Drainage:
 - a. Entire System: Tightly close all openings except the highest one. Fill to overflowing with water.
 - b. Sections of System: Tightly close all openings except the highest opening of the section under test. Fill section with water to test each section with a minimum 10-foot head of water except for the uppermost 10 feet of the system.
 - c. Allow to stand for (4) hours or longer, as required to complete the inspection.
2. Domestic Water: Fill with water and test at 150 psig. Retain for (4) hours.
3. Gas Piping: Air test to pressure equal to one and one-half times the design pressure, but in no case less than 50 psig. Retain for four hours.
- E. After all Systems have been tested as outlined, all flow rates shall be balanced, and all control devices adjusted. See Section 23 00 00.
- F. The equipment and installations shall be operated by the Contractor and he shall demonstrate that all Systems are performing according to the requirements of the Plans and Specifications and to the satisfaction of the Architect, Engineer and Owner.
- G. Acceptance Testing Requirements: For applicable acceptance tests see the energy compliance documentation. Acceptance testing shall be the responsibility of the mechanical contractor and shall be performed by an Acceptance Testing Technician who has been certified by a California Energy Commission approved Acceptance Test Technician Certification Provider Program. The Test and Balance Contractor can also be the Acceptance Testing Technician

3.9 CUTTING AND PATCHING

- A. The Contractor shall do all cutting and patching which may be required for the installation of the Work under this Division of the Specifications. Patching shall be of the same quality, materials and finish as, and shall match accurately, all surrounding construction. No cutting of the Structure shall be permitted without the approval of the Architect.
- B. Wherever concrete or paved surfaces are cut to provide for the installation under this Section, the Contractor shall restore the surfaces to their original condition. Subgrade materials, concrete, and paving materials, along with the placement of same, shall be in accordance with the respective Sections of this Specification as they apply to the installation of such material.

3.10 EXCAVATION AND BACKFILL: (BURIED PIPES WITHIN THE BUILDING WALLS AND TO 5 FEET FROM THE BUILDING.)

- A. Dig trenches straight and true to line and grade; bottom shall be left smoothed of rock points. Pipe shall be supported for the entire length on undisturbed, original earth. The minimum trench width shall be 16" and all pipe shall be 2 feet below the finished grade, minimum, wherever conditions permit. Sewer pipes to be

below grade as necessary to meet the slope and invert on the Drawing. Whenever substantial variations of pipe bury is indicated by field conditions, the proposed changes in depth of bury shall be submitted, in writing, to the Architect for approval.

- B. All piping shall be laid on a bed of clean dry sand not less than 6" thick. The space between the pipe and the sides of the trench shall be backfilled with clean dry sand to a point 6" above the crown of the pipe. Both sides of the pipe shall be filled at the same time.
- C. The remainder of the trench shall be backfilled with native soil in lifts no greater than 12" and shall be mechanically compacted by tamping so to maintain a minimum relative dry density of 95%, determined by California Impact Test Method No. 216.
- D. All backfilling shall be brought flush with finished subgrade.
- E. Excess material shall be removed from the site. Trenches shall be backfilled immediately after approval.

3.11 INSTALLATION OF PIPING, DUCTWORK AND EQUIPMENT

- A. The installation of piping, ductwork, and equipment shall be made in such a manner to clear beams and obstructions. Do not cut into or reduce the size of plates or any load carrying members without approval of the Architect. Check Drawings and Work of others to prevent interference. Deviations of the Work determined by the Architect shall be installed by the Contractor without additional cost.
- B. Install piping and ductwork promptly, cap or plug open ends of pipe. No piping shall be permanently covered by construction before inspection and approval. Piping and ductwork shall be installed in accordance with best practice and recommendations of the manufacturer.
- C. Conceal piping and ductwork unless indicated otherwise. Inspect each piece of pipe, tubing, fittings, and equipment for defects and obstructions. Remove defective material from site. Install piping generally level, free of traps and unnecessary bends to conform with building requirements, and provide space for other work. Piping to be free of unusual noises. Avoid any possible galvanic action by isolating dissimilar metals with suitable Dielectric Insulating Fittings.
- D. Unless called for otherwise, hereinafter in this Specification or by specific detail on the Drawings, all water pipes in contact with structure and/or hangers shall be suitably isolated. In the case of uninsulated pipe, "Trisolators" or equal shall be used.
- E. Protect enameled or polished equipment from damage, tool marks, etc.

3.12 STERILIZATION OF PIPES

- A. After preliminary purging of the Systems, the entire domestic potable water system pertaining to Work under this Contract shall be chlorinated in accordance with American Water Works Association, State of California Health and Safety Code procedure for disinfecting water mains. A thorough flushing operation shall be run upon completion of sterilization. Contractor shall then arrange with local

health authority for test on mains and water systems and provide three (3) copies of test results to the Architect.

3.13 EQUIPMENT IDENTIFICATION TAGS

A. Major pieces of equipment shall include, but are not limited to: water heaters, air conditioners, unit heaters, supply and exhaust fans, and shall be tagged.

1. Tags shall be 2" x 2" x 1/8" thick Formica/plastic engraving stock beveled on both sides and with two 3/16" diameter holes near the top uppermost tag corners.
2. Tags shall be white with 3/8" high red engraved letters.
3. Tags shall be attached to the equipment with bolts, screws or chains as per valves.
4. Tags shall have the following information:
 - a. Equipment number and nomenclature corresponding to the information on the mechanical contract drawings.
 - b. Examples:

WH	EF	AC
1	2	3

3.14 IDENTIFICATION OF PIPING SYSTEMS

A. Building Systems:

1. Piping systems installed anywhere within the scope of the Work shall be identified as to contents using a color banding and marking system as outlined and in compliance with Federal OSHA requirements.
2. This Work includes furnishing and application of all snap-around and/or self-sticking pipe markers. Formica valve tags, chains, wires, and related materials proper for the completion of the Work.
3. Pipe markers shall be permanently shaped vinylite plastic snap-around pipe markers as manufactured by Seton Nameplate Corporation, Wilmington Plastic Company, or approved equal.
4. A maximum of four basic background colors shall be used and they shall conform to the American Standards Association Standard A13.1, "Scheme For Identification of Piping Systems" The names of materials (pipe contents) shall be superimposed on these ANSI background colors. Work legends shall conform to ANSI A13.1 to avoid confusion and mistakes. Basic background colors and content classification are:

Yellow	Dangerous Materials
Red	Fire Protection
Bright Blue	Protective Materials
Green	Safe Materials

5. Pipe marking and installation shall be as follows:
 - a. Apply "Plastic Pipe Marker" at each valve to show proper identification of pipe contents.

- b. Use an "Arrow Marker" with each "Pipe Content Marker". The Arrow shall always point away from the "Pipe Marker" and in the direction of the flow.
 - c. If flow can be in both directions, use a double-header "Arrow Marker".
 - d. Apply "Pipe Marker" and "Arrow Marker" at every point of pipe entry and exit where the line goes through the wall, floor or roof.
 - e. Apply "Pipe Marker" and "Arrow Marker" on each riser and "T" joint.
 - f. Apply "Pipe Marker" and "Arrow Marker" every 50 feet on long continuous lines.
 - g. Identifying long continuous lines with "Pipe Marker and "Arrow Marker at every bay or aisle within the building. All branch runs from mains on the roof shall be identified with "Pipe Marker" and "Arrow Marker" at the point of takeoff.
 - h. Apply "Markers" on the two lower quarters of the pipe where view is unobstructed. In this position "Markers" are read at a glance from ground floor level and dust will not obscure the "Marker". Roof-mounted piping "Markers" shall be so located that they can be read from a standing position on the roof.
 - i. All identification markers located out of doors and exposed to the sun and the elements shall receive one coat of clear lacquer after application to the pipe, to seal edges and to act as a protective coating.
 - j. Each "Arrow Marker" must have the same ANSI background color as its companion "Pipe Marker". Arrow must point away from "Pipe Marker" and indicate direction of flow.
 - k. "Pipe Markers" shall be guaranteed to stay on pipe systems for a period of not less than five years.
6. Following is a list of, but not necessarily limited to, the more commonly used piping systems that require identification "Pipe Markers" and "Arrow Markers".

Abbreviations on Drawings	Wording to Put on Pipe Marker	ANSI Color Background
CW	Domestic Cold Water	Green
DHWS	Domestic Hot Water Supply	Yellow
S	Gravity Sewer or Drain	Green
V	Vent	Green
G	Natural Gas	Yellow
All lettering shall be black on the yellow background and white on all other background.		

3.15 SEISMIC BRACING

- A. It shall be required that pipes, ducts and conduits be supported and braced per the 2022 CBC, sections 1617A.1.18 through 1617A.1.26 and ASCE 7-16 chapters 13, 26, and 30.

3.16 OPERATION AND INSTRUCTION

- A. The Contractor shall furnish competent Technicians to supervise start-up operations of equipment specified by the Architect or Engineer and to instruct Owner's operators. The Contractor shall furnish six complete sets of operating instructions and service manuals to the Architect.
- B. Instruction period shall be started after instruction books and service manuals have been submitted to and approved by the Architect and shall be at hours (regular and non-regular) arranged by the Architect.
- C. Service manuals shall include oiling, cleaning, and servicing data, compiled in clearly and easily understood form and in a durable binder. Data shall show all serial numbers of every piece of equipment and complete list of replacement parts.

3.17 WARRANTY

- A. The contractor shall warranty all of the systems for proper operation installed by the contractor for not less than one calendar year from date of project completion. This completion date shall be set by the Architect or Owner.

END OF SECTION

SECTION 260500
GENERAL ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete all electrical installations that are shown on the Drawings, included in these specifications, or otherwise needed for a complete and fully operating facility.
- B. Furnish and install all required in-place equipment, conduits, conductors, cables and any miscellaneous materials for the satisfactory interconnection and operation of all associated electrical systems.

1.02 RELATED WORK:

- A. This Section provides the basic Electrical Requirements which supplement the General Requirements of Division 01 and apply to all Sections of Division 26.

1.03 SUBMITTALS:

- A. As specified in Division 01. Submit to the Architect shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system specified. Information to be submitted includes manufacturer's descriptive literature of cataloged products, equipment, drawings, diagrams, performance and characteristic curves as applicable, test data and catalog cuts. Obtain written approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review. Furnish manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Industry and Technical Society Publication References, and years of satisfactory service of each item required to establish contract compliance. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval.
- B. Organize submittals for equipment and items related to each specification section together as a package.
- C. Proposed substitutions of products will not be reviewed or approved prior to awarding of the Contract.
- D. Substitutions shall be proven to the Architect or Engineer to be equal or superior to the specified product. Architect's decision is final. The Contractor shall pay all costs incurred by the Architect and Engineer in reviewing and processing any proposed substitutions whether or not a proposed substitution is accepted.
- E. If a proposed substitution is rejected, the contractor shall furnish the specified product at no increase in contract price.

- F. If a proposed substitution is accepted, the contractor shall be completely responsible for all dimensional changes, electrical changes, or changes to other work which are a result of the substitution. The accepted substitution shall be made at no additional cost to the owner or design consultants.

1.04 QUALITY ASSURANCE:

- A. Codes: All electrical equipment and materials, including installation and testing, shall conform to the latest editions following applicable codes:
 - 1. California Electrical Code (CEC).
 - 2. Occupational Safety and Health Act (OSHA) standards.
 - 3. All applicable local codes, rules and regulations.
 - 4. Electrical Contractor shall possess a C-10 license and all other licenses as may be required. Licenses shall be in effect at start of this contract and be maintained throughout the duration of this contract.
- B. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.
- C. Standards: Equipment shall conform to applicable standards of American National Standards Institute (ANSI), Electronics Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and National Electrical Manufacturers Association (NEMA).
- D. Underwriter Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Provide service entrance labels for all equipment required by the NEC to have such labels.
- E. The electrical contractor shall guarantee all work and materials installed under this contract for a period of one (1) year from date of acceptance by owner.
- F. All work and materials covered by this specification shall be subject to inspection at any and all times by representatives of the owner. Work shall not be closed in or covered before inspection and approval by the owner or his representative. Any material found not conforming with these specifications shall, within 3 days after being notified by the owner, be removed from premises; if said material has been installed, entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the contractor.

1.05 CONTRACT DOCUMENTS:

- A. Drawings and Specifications:
 - 1. In the case of conflict between the drawings and specifications, the specifications shall take precedence.

2. Drawings and specifications are intended to comply with all law, ordinances, rules and regulations of constituted authorities having jurisdiction, and where referred to in the Contract Documents, said laws, ordinance, rules and regulations shall be considered as a part of said Contract Documents within the limits specified. The Contractor shall bear all expenses of correcting work done contrary to said laws, ordinance, rules and regulations if the Contractor knew or should have known that the work as performed is contrary to said laws, ordinances, rules and regulations and if the Contractor performed same (1) without first consulting the Architect for further instructions regarding said work and/or (2) disregarded the Architect's instructions regarding said work.
- B. Drawings: The Electrical Drawings shall govern the general layout of the completed construction.
1. Locations of equipment, panels, pullboxes, conduits, stub-ups, ground connections are approximate unless dimensioned; verify locations with the Architect prior to installation.
 2. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for those installations.
 3. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Architect for approval.
 4. The general arrangement and location of existing conduits, piping, apparatus, etc., is approximate. The drawings and specifications are for the assistance and guidance of the contractor, exact locations, distances and elevations are governed by actual field conditions. Accuracy of data given herein and on the drawings is not guaranteed. Minor changes may be necessary to accommodate work. The contractor is responsible for verifying existing conditions. Should it be necessary to deviate from the design due to interference with existing conditions or work in progress, claims for additional compensation shall be limited to those for work required by unforeseen conditions as determined by the Architect.
 5. All drawings and divisions of these specifications shall be considered as whole. The contractor shall report any apparent discrepancies to the Architect prior to submitting bids.
 6. The contractor shall be held responsible to have examined the site and compared it with the specifications and plans and to have satisfied himself as to the conditions under which the work is to be performed. He shall be held responsible for knowledge of all existing conditions whether or not accurately described. No subsequent allowance shall be made for any extra expense due to failure to make such examination.

1.06 Closeout Submittals:

- A. Manuals: Furnish manuals for equipment where manuals are specified in the equipment specifications or are specified in Division 01.

1.07 COORDINATION:

- A. Coordinate the electrical work with the other trades, code authorities, utilities and the Architect.
- B. Provide and install all trenching, backfilling, conduit, pull boxes, splice boxes, etc. for all Utility Company services to the locations indicated on the Drawings. All materials and construction shall be in accordance with the requirements for all the Utility Companies. Prior to performing any work, the Electrical Contractor shall coordinate with the various Utility Companies and obtain utility company engineering drawings. Verify that all such work and materials shown on the Drawings are of sufficient sizes and correctly located to provide services on the site. The Electrical Contractor shall verify with all the Utility Companies that additional contractor furnished and installed work is not required. If additional work, materials, or changes are required by any of the Utility Companies, the Electrical Contractor shall advise the Architect of such changes and no further work shall then be performed until instructed to do so by the Architect. The Electrical Contractor shall coordinate with the various Utility Companies to schedule inspections and to obtain service connections.
- C. The Electrical Contractor shall schedule all utility work necessary for utility inspections, connections, cable installation, etc. for the new electrical service to meet the construction schedule.
- D. Utility Company charges shall be paid by the Owner.
- E. Contractor shall pay all inspection and other applicable fees and procure all permits necessary for the completion of this work.
- F. Where connections must be made to existing installations, properly schedule all the required work, including the power shutdown periods.
- G. When two trades join together in an area, make certain that no electrical work is omitted.

1.08 JOB CONDITIONS:

- A. Operations: Perform all work in compliance with Division 01
 - 1. Keep the number and duration of power shutdown periods to a minimum.
 - 2. Show all proposed shutdowns and their expected duration on the construction schedule. Schedule and carry out shutdowns so as to cause the least disruption to operation of the Owner's facilities.
 - 3. Carry out shutdown only after the schedule has been approved, in writing, by the owner. Submit power interruption schedule 15 days prior to date of interruption.
- B. Construction Power: Unless otherwise noted in Division 01 of these specifications, contractor shall make all arrangements and provide all necessary facilities for temporary construction power to the site. Energy costs shall be paid by the General Contractor.

- C. Storage: Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from weather, dust, water, or construction operations.

1.09 DAMAGED PRODUCTS:

- A. Notify the Architect in writing in the event that any equipment or material is damaged. Obtain approval from the Architect before making repairs to damaged products.

1.10 LOCATIONS:

- A. General: Use equipment, materials and wiring methods suitable for the types of locations in which they are located.
- B. Dry Locations: All those indoor areas which do not fall within the definition below for Wet Locations and which are not otherwise designated on the Drawings.
- C. Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.

1.11 SAFETY AND INDEMNITY:

- A. The Contractor is solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continually and not be limited to normal working hours. The contractor shall provide and maintain throughout the work site proper safeguards including, but not limited to, enclosures, barriers, warning signs, lights, etc. to prevent accidental injury to people or damage to property.
- B. No act, service, drawing review or construction review by the Owner, the Engineer or their Consultants is intended to include reviews of the adequacy of the Contractors safety measures in or near the construction site.
- C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify, and defend the Owner, the Engineer, their consultants, and each of their officers, agents and employees from any and all liability claims, losses, or damage arising out of or alleged to arise from bodily injury, sickness, or death of a person or persons and for all damages arising out of injury to or destruction of property arising directly or indirectly out of or in connection with the performance of the work under this Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the construction contract documents, but not including liability that may be due to the sole negligence of the Owner, the Engineer, their Consultants or their officers, agents and employees.
- D. If a work area is encountered that contains hazardous materials, the contractor is advised to coordinate with the owner and its abatement consultant for abatement of hazardous material by the Owner's Representative. "Hazardous materials" means any toxic substance regulated or controlled by OSHA, EPA, State of California or local rules, regulations and laws. Nothing herein shall be construed to create a liability for

Aurum Consulting Engineers regarding hazardous materials abatement measures, or discovery of hazardous materials.

1.12 ACCESS DOORS:

- A. The contractor shall install access panels as required where floors, walls or ceilings must be penetrated for access to electrical, control, fire alarm or other specified electrical devices. The minimum size panel shall be 14" x 14" in usable opening. Where access by a service person is required, minimum usable opening shall be 18" x 24".
- B. All access doors installed lower than 7'-0" above finished floor and exposed to public access shall have keyed locks.
- C. Where specific information or details relating to access panels differ from Division 26 paragraph 1.12 of these specifications, or shown on the electrical drawings and details or under other Divisions of work, those requirements shall supersede these specifications.

1.13 ARC FLASH:

- A. The contractor shall install a clearly visible arc flash warning to the inside door of all panelboards and industrial control panels, as well as to the front of all switchboards and motor control centers that are a part of this project.
- B. The warning shall have the following wording: line 1 "WARNING" (in large letters), line 2 "Potential Arc Flash Hazard" (in medium letters), line 3 & 4 "Appropriate Personal Protective Equipment and Tools required when working on this equipment".

1.14 EMERGENCY BOXES:

- A. All boxes and enclosures for emergency circuits shall be permanently marked with a readily visible red spray-painted mark.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY:

- A. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are established to be equal to the specified product and approved by the Architect prior to installation.
- B. Material and Equipment: Provide materials and equipment that are new and are current products of manufacturers regularly engaged in the production of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period includes use of equipment and materials of similar size under similar circumstances. For uniformity, only one manufacturer will be accepted for each type of product.

- C. Service Support: Submit a certified list of qualified permanent service organizations including their addresses and qualification for support of the equipment. These service organizations shall be convenient to the equipment installation and able to render service to the equipment on a regular and emergency basis during the warranty period of the contract.
- D. Manufacturer's Recommendations: Where installation procedures are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendation shall be cause for rejection of the equipment or material.

2.02 NAMEPLATES:

- A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings, the model designation, and shop order number.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved plastic nameplate. Unless otherwise noted, nameplates shall be melamine plastic 0.125-inch-thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 0.5 by 2.5 inches unless otherwise noted. Where not otherwise specified, lettering shall be a minimum of 0.25-inch-high normal block style. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel or brass screws.

2.03 FASTENERS:

- A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel.

2.04 FINISH REQUIREMENTS:

- A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Architect.
- B. Wiring System: In finished areas, paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed.

PART 3 - EXECUTION

3.01 WORKMANSHIP:

- A. Ensure that all equipment and materials fit properly in their installation.
- B. Perform any required work to correct improperly fit installation at no additional expense to the owner.

- C. All electrical equipment and materials shall be installed in a neat and workmanship manner in accordance with the "NECA-1 Standard Practices for Good Workmanship in Electrical Contracting". Workmanship of the entire job shall be first class in every respect.

3.02 EQUIPMENT INSTALLATIONS:

- A. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
- B. Do all the cutting and patching necessary for the proper installation of work and repair any damage done.
- C. Earthquake restraints: all electrical equipment, including conduits over 2 inches in diameter, shall be braced or anchored to resist a horizontal force acting in any direction as per CBC Section 1616A Title 24, part 2 and ASCE7-10, Sections 13.3 and 13.6 and Table 13.6-1.
- D. Structural work: All core drilling, bolt anchor insertion, or cutting of existing structural concrete shall be approved by a California registered structural consulting engineer prior to the execution of any construction. At all floor slabs and structural concrete walls to be drilled, cut or bolt anchors inserted, the contractor shall find and mark all reinforcing in both faces located by means of x-ray, pach-ometer, or prof-ometer. Submit sketch showing location of rebar and proposed cuts, cores, or bolt anchor locations for approval.

3.03 FIELD TEST:

- A. Test shall be in accordance with Acceptance testing specifications issued by the National Electrical Testing Association (NETA).
- B. Perform equipment field tests and adjustments. Properly calibrate, adjust and operationally check all circuits and components, and demonstrate as ready for service. Make additional calibration and adjustments if it is determined later that the initial adjustments are not satisfactory for proper performance. Perform equipment field test for equipment where equipment field tests are specified in the equipment Specifications. Give sufficient notice to the Architect prior to any test so that the tests may be witnessed.
- C. Provide instruments, other equipment and material required for the tests. These shall be of the type designed for the type of tests to be performed. Test instrument shall be calibrated by a recognized testing laboratory within three months prior to performing tests.
- D. Operational Tests: Operationally test all circuits to demonstrate that the circuits and equipment have been properly installed and adjusted and are ready for full-time service. Demonstrate the proper functioning of circuits in all modes of operation, including alarm conditions.
- E. Re-testing will be required for all unsatisfactory tests after the equipment or system has been repaired. Re-test all related equipment and systems if required by the

Architect. Repair and re-test equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.

F. Maintain records of each test and submit five copies to the Architect when testing is complete. All tests shall be witnessed by the Architect. These records shall include:

1. Name of equipment tested.
2. Date of report.
3. Date of test.
4. Description of test setup.
5. Identification and rating of test equipment.
6. Test results and data.
7. Name of person performing test.
8. Owner or Architect's initials.

G. Items requiring testing shall be as noted in the additional electrical sections of these specifications.

3.04 CLEANING EQUIPMENT:

A. Thoroughly clean all soiled surfaces of installed equipment and materials.

3.05 PAINTING OF EQUIPMENT:

A. Factory Applied: Electrical equipment shall have factory applied painting system which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical section.

B. Field Applied: Paint electrical equipment as required to match finish of adjacent surfaces.

3.06 RECORDS:

A. Maintain one copy of the contract Drawing Sheets on the site of the work for recording the "as built" condition. After completion of the work, the Contractor shall carefully mark the work as actually constructed, revising, deleting and adding to the Drawing Sheets as required. The following requirements shall be complied with:

1. Cable Size and Type: Provide the size and type of each cable installed on project.
2. Substructure: Where the location of all underground conduits, pull boxes, stub ups and etc. where are found to be different than shown, carefully mark the

correct location on the Drawings. Work shall be dimensioned from existing improvements.

3. Size of all conduit runs.
4. Routes of concealed conduit runs and conduit runs below grade.
5. Homerun points of all branch circuit.
6. Location of all switchgear, panels, MCC, lighting control panels, pullcans, etc.
7. Changes made as a result of all approved change orders, addendums, or field authorized revisions.
8. As Builts: At the completion of the Work the Contractor shall review, certify, correct and turn over the marked-up Drawings to the Architect for his use in preparing "as built" plans.
9. As built Drawings shall be delivered to the Architect within ten (10) days of completion of construction.

3.07 CLEAN UP:

- A. Upon completion of electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Architect.

3.08 MECHANICAL AND PLUMBING ELECTRICAL WORK:

- A. The requirements for electrical power and/or devices for all mechanical and plumbing equipment supplied and/or installed under this Contract shall be coordinated and verified with the following:
 1. Mechanical and Plumbing Drawings.
 2. Mechanical and Plumbing sections of these Specifications.
 3. Manufacturers of the Mechanical and Plumbing equipment supplied.
- B. The coordination and verification shall include the voltage, ampacity, phase, location and type of disconnect, control, and connection required. Any changes that are required as a result of this coordination and verification shall be a part of this Contract.
- C. The Electrical Contractor shall furnish and install the following for all mechanical and plumbing equipment:
 1. Line voltage conduit and wiring.
 2. Disconnect switches.
 3. Manual line motor starters.
- D. Automatic line voltage controls and magnetic starters shall be furnished by the Mechanical and/or Plumbing Contractor and installed and connected by the Electrical Contractor. When subcontracted for by the Mechanical and/or Plumbing Contractor, all

line voltage control wiring installed by the Electrical Contractor shall be done per directions from the Mechanical and/or Plumbing Contractor.

- E. All low voltage control wiring for Mechanical and Plumbing equipment shall be installed in conduit. Furnishing, installation and connection of all low voltage conduit, boxes, wiring and controls shall be by the Mechanical and/or Plumbing Contractor.
- F. Disconnects (Motor and Circuit)
 - 1. Disconnect switches shall be provided and located at all motors.
 - 2. Switches for three-phase motors shall be heavy-duty, horsepower rated three-pole, and surface mounted except as noted on drawings.
 - 3. Switches containing more than three poles shall be as specified on the drawings.
 - 4. Switches for single-phase, fractional horsepower motors shall be heavy-duty, horsepower rated.
 - 5. Disconnect switches shall be as manufactured by ITE- Siemens, General Electric or Square D.
- G. Disconnects (Motor: Fused):
 - 1. Disconnect switches shall be provided and located at all motors.
 - 2. Switches for three-phase motors shall be heavy-duty, horsepower rated three-pole, and surface mounted except as noted on drawings.
 - 3. Switches containing more than three poles shall be as specified on the drawings.
 - 4. Switches for single-phase, fractional horsepower motors shall be heavy-duty, horsepower rated.
 - 5. Disconnect switches shall be as manufactured by ITE- Siemens, General Electric or Square D.
- H. Manual motor starters, where required, shall have toggle type operators with pilot light and melting alloy type overload relays, SQUARE D COMPANY, Class 2510, Type FG-1P (surface) or Type FS-1P (flush) or ITE, WESTINGHOUSE or GENERAL ELECTRIC equal.

END OF SECTION

SECTION 26 0513

MEDIUM VOLTAGE CABLE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

- A. 25kV Class Cable - EPR insulated, stranded copper conductor as specified, shielded, jacketed, power cable rated for 25kV operation, suitable for use in dry and wet locations in conduit and underground duct.
- B. 15kV Class Cable - EPR insulated, stranded copper conductor as specified, shielded, jacketed, power cable rated for 15kV operation, suitable for use in dry and wet locations in conduit and underground duct.
- C. 5kV Class Cable - EPR insulated, stranded copper conductor as specified, shielded, jacketed, power cable rated for 5kV operation, suitable for use in dry and wet locations in conduit and underground duct.

1.3 SPECIFICATION FOR RELATED WORK

- A. See the following Specification Sections for work related to the work in this Section.
 - 1. 26 05 00 General Electrical Requirements.
 - 2. 26 05 43 Underground Ducts.
 - 3. 26 05 14 Medium Voltage Cable Connectors.

1.4 STANDARDS AND CODES

- A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes. Where differences exist between codes, standards and referenced specifications, the one with the strictest requirements shall govern:
 - 1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATION:
 - a. B3-01, Specifications for Soft or Annealed Copper Wire.
 - b. B8-04, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
 - c. B496-04, Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.

2. ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC) PUBLICATION:
 - a. CS8-00, Specification for Extruded Dielectric Shielded Power Cables Rated 5 through 69kV.
3. FEDERAL STANDARD (FED. STD.):
 - a. 228, Methods of Testing Insulated Cable and Wire.
4. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA) / NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) JOINT PUBLICATION:
 - a. ICEA S-93-639, NEMA WC 74 Shielded Power Cables 5,000 - 46,000 V.
5. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) INSULATED CABLE ENGINEERS ASSOCIATION (ICEA) JOINT PUBLICATION:
 - a. ANSI/ICEA S-97-682-2000 Utility Shielded Power Cables Rated 5 through 46kV.
6. NATIONAL FIRE PROTECTION AGENCY (NFPA) PUBLICATION:
 - a. NFPA 70, National Electrical Code (NEC).
7. INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA) PUBLICATION:
 - a. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, 2003.
8. UNDERWRITERS LABORATORIES (UL) PUBLICATION:
 - a. UL 1072, Medium-Voltage Power Cables.

1.5 SUBMITTALS

- A. As specified in Division 01, Section 26 05 00.
- B. Catalog Data - Submit manufacturer's published descriptive literature and specification sheets for cable.
- C. Factory Tests - Submit factory test data, as described herein under QUALITY ASSURANCE.
- D. Field Tests - Submit field test data as described under PART 3 herein.

1.6 QUALITY ASSURANCE

- A. Qualification tests in compliance with AEIC CS8-00 are required for each shielded cable furnished.
- B. Testing of the completed cable shall be in accordance with ICEA S-97-682 and UL 1072. In addition, all cables utilizing a semi-conducting strand screen shall be tested for partial Discharge Corona (Extinction) Level values per AEIC CS8-00. Production tests shall include:
 1. Aging.
 2. Voltage.

3. Insulation Resistance.
 4. Corona Level (as applicable), including an X-Y plot of the Corona test values.
 5. Discharge Resistance.
- C. Maintenance of Water Tight Seal - If the cable is not shipped to the job site from the place of manufacture, provide documented history of ownership and handling.
- D. Field Tests - The completed terminated cable installation will be AC HiPot tested by the Contractor as specified in PART 3 of this Section. Test insulation value must equal or exceed 90% of the factory test insulation value. Cable failing to show this value must be re terminated and/or replaced at no cost to the Owner.
- E. Observations by the Owner's Representative:
1. Set Up - Must be inspected and approved by the Owner's Representative, prior to pulling cable.
 2. Installation Operation - Must be witnessed by the Owner's Representative.
 3. Cable termination and testing - Must be witnessed by the Owner's Representative.

1.7 SHIPPING AND HANDLING

- A. After testing at the place of manufacture and cutting to lengths, cable ends shall be sealed water tight with heat shrink or pre-shrink caps over the jacket.
- B. Cable shall be shipped in parallel in lengths specified in the cable order. Cable shall be lagged with suitable lagging to protect the cable from damage during shipping. Both cable ends shall be accessible to permit high potential testing prior to installation.
- C. Identification – Cable packaging shall have printed directly on, or on a firmly attached weatherproof metal or plastic tag, the following information:
1. Manufacturer's Name.
 2. Conductor Material.
 3. Conductor Size.
 4. Insulation Type and Thickness.
 5. Jacket Thickness.
 6. Temperature Rating.
 7. Length of Cable.
 8. Manufacturer's Cable Type.
 9. Voltage Class.
 10. Purchaser's Purchase Order Number and Item Number.
 11. Cable Weight.
 12. Reel Weight.
 13. Shielded or Non-Shielded.
 14. Reel Number.

1.8 WARRANTY

- A. The cable shall be warranted to be free of defects for a period of 5 years from the date of shipment from the factory. In case of failure of the cable, due to material or manufacturing defects, the cable shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Medium voltage cable shall be manufactured by Okonite Cable Corp., Kerite or equal.

2.2 CABLE CONSTRUCTION

- A. General - 5kV shielded single conductor, copper, ethylene-propylene-rubber (EPR) insulated, shielded, jacketed, type MV-105 power cable per the NEC and bearing the UL label. Cables shall be suitable for use in wet or dry locations, in metallic or non-metallic conduits or ducts.
- B. Conductor - The conductor materials shall be annealed un-coated copper conforming to ASTM B-3. Conductors shall be Class B stranded copper, either concentric stranded in accordance with ASTM B-8 or compact-round stranded in accordance with ASTM B-496.
- C. Conductor Shield - The conductor strand shield shall be either an extruded semiconducting EPR compound or a non-conducting, extruded stress control layer.
 - 1. Semiconducting strand screens shall be an extruded semiconducting thermosetting compound compatible with both the insulation and conductor and shall have an allowable operating temperature equal to that of the insulation. The conductor shield shall conform to the requirements of ICEA S-97-682.
 - 2. Cables having a non-conductive strand screen shall use an extruded energy suppression and stress control material which is continuously tested during the extrusion process to assure that there are no voids between the strand screen and the conductor.
- D. Insulation - Cable insulation shall be EPR, 220 mils average thickness, 133% insulation level, resistant to heat, moisture, ozone and corona. Other synthetic EP based insulation are acceptable if they meet the above criteria and are resistant to degradation from ozone and electrical discharge as proven by the ability of the insulation to withstand continuous exposure to electrical discharge for more than 2000 hours when energized at a test potential equal to 250 volts/mil of insulation thickness as specified in ICEA S-97-682.
- E. Temperature Rating - The insulated power cable shall be rated to operate at a maximum continuous conductor temperature of 105°C for normal operation, 130°C for emergency overload conditions and 250°C for short circuit conditions. Emergency overload operation may occur for periods up to 100 hours per year, with as many as five such periods within the lifetime of the cable.

- F. Insulation Shield - The insulation shield shall be an extruded layer of semiconducting EPR laid directly over the insulation. Cables using an extruded energy suppression and stress control material for the strand screen may use a semiconducting thermoplastic polymer material, instead of the semiconducting layer of EPR for the insulation shield.
- G. Free Stripping - The shield shall be in intimate continuous contact with the insulation and shall be free stripping without the use of heat, cutting or the need for machine removal. Shield shall comply with ICEA requirements and testing.
- H. Tape Shield - Spiral-wrapped copper tape, 5 mils min., with 12.5% overlap minimum.
- I. Jacket - The jacket shall be an extruded layer of polyvinyl chloride having a minimum average thickness of 80 mils.

2.3 CABLE IDENTIFICATION

- A. The following information shall be permanently indicated by a surface legend printed in compatible ink of contrasting color, at intervals not exceeding 24 inches over the entire length of the cable:
 - 1. Manufacturer's Name.
 - 2. Conductor Material.
 - 3. Conductor Size.
 - 4. Maximum Rated Voltage.
 - 5. Insulation Material.
 - 6. Letter Designating Cable Type.
 - 7. Shielded or Non-shielded.
 - 8. Year of Manufacture.
 - 9. UL Listing.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION

- A. Maintaining Water Tightness - The cable received is specified to be sealed water tight on each end. This seal shall be maintained at ALL TIMES, except, when the cable end is being terminated.
- B. Setting Up - Cable shall be unloaded in such a manner as to avoid contact with the cable. Forklifts may be used for unloading ONLY IF the cable is on a pallet. Cable slings, or other lifting attachments, shall be placed so that they do not put ANY pressure on the cable.
- C. Marking and Identification - Color code phase identification of medium voltage cables as follows:
 - PHASE A- YELLOW
 - PHASE B- RED

PHASE C- BLUE
GROUND- BARE

- D. Cable installation shall be in accordance with the manufacturer approved pulling plan specified under paragraph 1.04, "Submittals".

3.2 FIELD TEST

- A. General - All medium voltage cable will be AC HiPot tested by a certified testing agency, and paid for by the contractor.
- B. Required Insulation Values - Current readings will be used by the testing agency and the Owner's Representative to determine insulation values of cable being installed. Test insulation value must equal or exceed 90% of the factory test insulation value. Cable failing to show this value must be reterminated at no cost to the Owner. If, on retesting, the reterminated cable fails to achieve the insulation value specified, it shall be replaced at no cost to the Owner.
- C. Contractor Cooperation - The Contractor shall prepare the work for testing, as required, shall cooperate in the conduct of the tests, and shall remove any work constructed specifically for the test after completion of the test.
- D. Notice Required - The Contractor shall give the Owner's Representative at least 5 working days notice in advance when the installation is ready for testing.
- E. Safety During Testing - The Contractor shall be responsible for insuring that sufficient barricading is placed to prevent access to energized equipment by unauthorized persons during the test.
- F. All cable lengths will be tested as specified by the Testing Agency with all termination's disconnected from equipment, unless specifically directed otherwise.
- G. High Potential Tests:

After cables are installed, a high potential test shall be performed on each conductor. An initial voltage shall be applied and increased in no less than 5 uniform steps up to the maximum test voltage. The minimum time at each step shall be no less than required for test current to stabilize. The high potential test shall be AC. The applied voltage shall be 60 Hz. If the applied voltage is interrupted at any time during the test on a conductor, the test shall be started again from the beginning.

Test potentials shall be as follows:

Nominal Cable Rating		AC Test
Initial Voltage	5 kV	5 kV
Final	5 kV	65 kV
Hold Voltage for (minutes)		5

Report of Test Results: Reports of voltage test results shall be submitted for review with three copies of each report prepared in the following format detail:

1. A separate 8-1/2 by 11-inch report sheet shall be prepared for each separately tested section of high voltage cable.
 2. Each report shall be headed with the project identification.
 3. The following additional data shall appear on each report sheet:
 - Date
 - Name of operator performing test
 - Company operator is employed by
 - Section of cable tested
 - Type of cable insulation
 - Cable length
 - Normal rating cable
 - Cable manufacturer and product identification
 - Size of conductor
 - Identification of test equipment
 4. The test results shall be plotted on a log-log graph and shall have microamperes on the left and kilovolts across the bottom. The graph shall also provide a current vs. time test to be recorded in 1-minute intervals after final test voltage has been reached.
 5. The operator of the test equipment shall sign each test report.
 6. The contractor or his authorized representative shall endorse each report sheet.
- H. Re-testing - After the Contractor has corrected any defects disclosed by the initial testing, the materials and/or installation shall be re-tested at the expense of the Contractor. Re-testing shall be by the same agency as performed the initial tests, in the same manner as the original tests were performed. The standard format appearance requires three paragraph returns between the last article and the END OF SECTION MARKER.

END OF SECTION 260513

SECTION 260519
LINE VOLTAGE WIRE AND CABLE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this Section consists of providing all wire and cable rated 600 volts or less, including splices and terminations, as shown on the Drawings and as described herein.

1.02 RELATED WORK:

- A. See the following Specification Section for work related to the work in this Section:
 - 1. 260542 Conduits, Raceways and Fittings.
 - 2. 260533 Junction and Pull Boxes.

1.03 QUALITY ASSURANCE

- A. Field tests shall be performed as specified in paragraph 3.04 of this Section.

PART 2 - PRODUCTS

2.01 CONDUCTORS:

- A. Conductors shall be copper, type THHN/THWN/MTW oil and gasoline resistant, 600 volt rated insulation.
- B. Conductors shall be stranded copper.
- C. Minimum power and control wire size shall be No. 12 AWG unless otherwise noted.
- D. All conductors used on this Project shall be of the same type and conductor material.

2.02 CABLES:

- A. All individual conductors shall be copper with type THHN/THWN, 600 volt rated insulation.
- B. [Nonmetallic – sheathed cable (Romex): Type “NM”, 600 volts rated with insulated copper conductors, No. 12 AWG minimum size, and internal copper ground wire.]
- C. Insulation Marking - All insulated conductors shall be identified with printing colored to contrast with the insulation color.
- D. Color Coding - As specified in paragraph 3.03.

- E. Special Wiring - Where special wiring is proposed by an equipment manufacturer, submit the special wiring requirements to the Owner's Representative and, if approved, provide same. Special wire shall be the type required by the equipment manufacturer.
- F. Other Wiring - Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and as approved by the Owner's Representative.
- G. Manufacturer - Acceptable manufacturers including Cablec, Southwire, or equal.

2.03 TERMINATIONS:

- A. Manufacturer - Terminals as manufactured by T&B, Burndy or equal.
- B. Wire Terminations – Stranded conductors shall be terminated in clamping type terminations which serve to contain all the strands of the conductor. Curling of a stranded conductor around a screw type terminal is not allowed. For screw type terminations, use a fork type stake-on termination on the stranded conductor. Use only a stake-on tool approved for the fork terminals selected.
- C. End Seals - Heat shrink plastic caps of proper size for the wire on which used.

2.04 TAPE:

- A. Tape used for terminations and cable marking shall be compatible with the insulation and jacket of the cable and shall be of plastic material.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION:

- A. Clean Raceways - Clean all raceways prior to installation of cables as specified in Section 260542 - Conduits Raceway and Fittings.
- B. All line voltage wiring shall be installed in conduit.
- C. All feeder conductors shall be continuous from equipment to equipment. Splices in feeders are not permitted unless specifically noted or approved by the Electrical Engineer.
- D. All branch circuit wiring shall be run concealed in ceiling spaces, walls, below floors or in crawl spaces unless noted otherwise.
- E. Cable Pulling - Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.

- F. Bending Radius - Cable bending radius shall be per applicable code. Install feeder cables in one continuous length.
- G. Equipment Grounding Conductors - Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in all conduits or all raceways.
- H. Panelboard Wiring - In panels, bundle incoming wire and cables which are No. 6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.

3.02 CABLE TERMINATIONS AND SPLICES:

- A. Splices - UL Listed wirenuts.
- B. Terminations - Shall comply with the following:
 1. Make up and form cable and orient terminals to minimize cable strain and stress on device being terminated on.
 2. Burnish oxide from conductor prior to inserting in oxide breaking compound filled terminal.

3.03 CIRCUIT AND CONDUCTOR IDENTIFICATION:

- A. Color Coding - Provide color coding for all circuit conductors. Insulation color shall be white for neutrals and green for grounding conductors. Conductor colors shall be as follows:

<u>VOLTAGE</u>	<u>208/120V</u>
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

- B. Color coding shall be in the conductor insulation for all conductors #10 AWG and smaller; for larger conductors, color shall be either in the insulation or in colored plastic tape applied at every location where the conductor is readily accessible.
- C. Circuit Identification - All underground distribution and service circuits shall be provided with plastic identification tags in each secondary box and at each termination. Tags shall identify the source transformer of the circuit and the building number(s) serviced by the circuit.

3.04 FIELD TESTS:

- A. All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than the requirements of the CEC. All circuits shall be tested for proper neutral connections.
- B. Insulation Resistance Tests: Perform insulation resistance tests on circuits with #2 AWG and larger conductors to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests before all equipment has been connected. Test the insulation with a 500Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.

END OF SECTION

SECTION 260526 GROUNDING

PART 1 GENERAL

1.01 Section Includes:

- A. Conduits, wires, ground rods and other materials for the electrical grounding system.

1.02 Related Sections:

- A. Section 26 05 00 - Electrical General Requirements.

PART 2 PRODUCTS

2.01 Ground Rod:

- A. "Copperweld" ground rod conforming to or exceeding requirements of U.L. Specification No. 467 (ANSI C-33.8). Rod shall be 3/4" diameter and 10' in length, unless otherwise noted on the Drawings.

2.02 Below Grade Connections:

- A. Compression fittings, Thomas & Betts, Series 52000, 53000 or 54000 or approved equal.

2.03 Hardware:

- A. Bolts, nuts and washers shall be bronze, cadmium plated steel or other non-corrosive materials, approved for the purpose.

2.04 Waterproof Sealant:

- A. Use Kearney "Aqua Seal" mastic sealant on all below grade clamp or compression type connections.

PART 3 EXECUTION

3.01 Grounding and Bonding:

- A. Grounding and bonding shall be as required by codes and local authorities.
- B. All electrical equipment shall be grounded, including, but not limited to, panel boards, terminal cabinets and outlet boxes.
- C. The ground pole of receptacles shall be connected to their outlet boxes by means of a copper ground wire connecting to a screw in the back of the box.

- D. A green insulated copper ground wire, sized to comply with codes, shall be installed in all conduit runs.
- E. All metal parts of pull boxes shall be grounded per code requirements.
- F. All ground conductors shall be green insulated copper.
- G. The ground system electrodes shall be tested for resistance before the equipment ground conductors are connected. Maximum ground system resistance shall be 25 ohms. Install up to two additional ground rods to meet the 25-ohm requirement. Multiple ground rods shall not be less than 10 feet apart.
- H. Grounding of the panels and relocatable. shall be completed as indicated on the Drawings.

END OF SECTION

SECTION 26 05 33
OUTLET, JUNCTION AND PULL BOXES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete all electrical installations shown on the drawings, included in these Specification, or otherwise needed for a complete and fully operating facility. The work shall include but not be limited to the following:
- B. Furnish and install all required material, supports and miscellaneous material for the satisfactory interconnection of all associated electrical systems.

1.02 RELATED WORK:

- A. See the following specification sections for work related to the work of this section.
 - 1. 260500 General Electrical Requirements.
 - 2. 260542 Conduits, Raceway and Fittings.
 - 3. 260519 Line Voltage Wire and Cable.

PART 2 - PRODUCTS

2.01 OUTLET BOXES, JUNCTION AND PULL BOXES

- A. Standard Outlet Boxes: Galvanized, steel, knock-out type of size and configuration best suited to the application indicated on the Drawings. Minimum box size shall be 4 inches square (octagon for most light fixtures) by 1-1/2 inches deep with mud rings as required.
- B. Switch boxes: Minimum box size shall be 4 inches square by 1-1/2 inches deep with mud rings as required. Install multiple switches in standard gang boxes with raised device covers suitable for the application indicated.
- C. Conduit bodies: Cadmium plated, cast iron alloy. Conduit bodies with threaded conduit hubs and neoprene gasketed, cast iron covers. Bodies shall be used to facilitate pulling of conductors or to make changes in conduit direction only. Splices are not permitted in conduit bodies. Crouse-Hinds Form 8 Condulets, Appleton Form 35 Unilets or equal.
- D. Sheet Metal Boxes: Use standard outlet or concrete ring boxes wherever possible; otherwise use a minimum 16-gauge galvanized sheet metal, NEMA I box sized to Code requirements with covers secured by cadmium plated machine screws located six inches on centers. Circle AW Products, Hoffman Engineering Company or equal.

- E. Flush Mounted Pull boxes and Junction boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.01 OUTLET BOXES

A. General:

1. All outlet boxes shall finish flush with building walls, ceilings and floors except in mechanical and electrical rooms above accessible ceiling or where exposed work is called for on the Drawings.
2. Install raised device covers (plaster rings) on all switch and receptacle outlet boxes installed in masonry or stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
3. Leave no unused openings in any box. Install close-up plugs as required to seal openings.

B. Box Layout:

1. Outlet boxes shall be installed at the locations and elevations shown on the drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
2. Locate switch outlet boxes on the latch side of doorways.
3. Outlet boxes shall not be installed back to back nor shall through-wall boxes be permitted. Outlet boxes on opposite sides of a common wall shall be separated horizontally by at least one stud or vertical structural member.
4. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height to agree with required location for equipment served.
5. On fire rated walls, the total face area of the outlet boxes shall not exceed 100 square inches per 100 square feet of wall area.

C. Supports:

1. Outlet Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Fixture outlet boxes installed in suspended ceiling of gypsum board or lath and plaster construction shall be mounted to 16-gauge metal channel bars attached to main ceiling runners.
3. Fixture outlet boxes installed in suspended ceilings supporting acoustical tiles or panels shall be supported directly from the structure above where pendant mounted lighting fixture are to be installed on the box.

4. Fixture Boxes above tile ceilings having exposed suspension systems shall be supported directly from the structure above.
5. Outlet and / or junction boxes shall not be supported by grid or fixture hanger wires at any locations.

3.02 JUNCTION AND PULL BOXES

A. General:

1. Install junction or pull boxes where required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not shown on the Drawings.
2. Locate pull boxes and junction boxes in concealed locations above accessible ceilings or exposed in electrical rooms, utility rooms or storage areas.
3. Install raised covers (plaster rings) on boxes in stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
4. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
5. Identify circuit numbers and panel on cover of junction box with black marker pen.

B. Box Layouts:

1. Boxes above hung ceilings having concealed suspension systems shall be located adjacent to openings for removable recessed lighting fixtures.

C. Supports:

1. Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Boxes installed in suspended ceilings of gypsum board or lath and plaster construction shall be mounted to 16-gauge metal channel bars attached to main ceiling runners.
3. Boxes installed in suspended ceilings supporting acoustical tiles or panels shall be supported directly from the structure above.
4. Boxes mounted above suspended acoustical tile ceilings having exposed suspension systems shall be supported directly from the structure above.

END OF SECTION

SECTION 260542
CONDUITS, RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this section consists of furnishing and installing conduits, raceways and fittings as shown on the Drawings and as described herein.

1.02 RELATED WORK:

- A. See the following specification sections for work related to the work in this section:

- 1. 26 05 43 Underground Ducts
- 2. 26 05 44 In Grade Pull Boxes
- 3. 26 05 19 Line Voltage Wire and Cable
- 4. 26 05 33 Junction and Pull Boxes

PART 2 - PRODUCTS

2.01 CONDUITS, RACEWAYS:

- A. Electrical Metallic Tubing (EMT) shall be hot-dip galvanized after fabrication. Couplings shall be compression or set-screw type.
- B. Flexible Conduit: Flexible metal conduit shall be galvanized steel.
- C. Galvanized Rigid Steel Conduit (GRS) shall be hot-dip galvanized after fabrication. Couplings shall be threaded type.
- D. Rigid Non-metallic Conduit: Rigid non-metallic conduit shall be PVC Schedule 40 (PVC-40 or NEMA Type EPC-40) conduit approved for underground use and for use with 90° C wires.

2.02 CONDUIT SUPPORTS:

- A. Supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer.
- B. Supports for multiple conduits shall be hot-dipped galvanized Unistrut or Superstrut channels, or approved equal. All associated hardware shall be hot-dip galvanized.
- C. Supports for EMT conduits shall be galvanized pressed steel single hole straps.
- D. Clamp fasteners shall be by wedge anchors. Shot in anchors shall not be allowed.

2.03 FITTINGS:

- A. Provide threaded-type couplings and connectors for rigid steel conduits; provide steel compression (watertight), or steel set-screw type for EMT, (die-cast zinc or malleable iron type fittings are not allowed). Provide threaded couplings and Meyers hubs for rigid steel conduit exposed to weather.
- B. Fittings for flexible conduit shall be Appleton, Chicago, IL, Type ST, O-Z Gedney Series 4Q by General Signal Corp., Terryville, CT, T & B 5300 series, or approved equal.
- C. Fittings for use with rigid steel shall be galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers and be Crouse Hinds Condulets, Syracuse, NY, Appleton Unilets, Chicago, IL, or approved equal. Provide threaded-type couplings and connectors; set-screw type and compression-type are not acceptable.
- D. Fittings for use with rigid non-metallic conduit shall be PVC and have solvent-weld-type conduit connections.
- E. Union couplings for conduits shall be the Erickson type and shall be Appleton, Chicago, IL, Type EC, O-Z Gedney 3-piece Series 4 by General Signal Corp., Terryville, CT, or approved equal. Threadless coupling shall not be used.
- F. Bushings:
 - 1. Bushings shall be the insulated type.
 - 2. Bushings for rigid steel shall be insulated grounding type, O-Z Gedney Type HBLG, Appleton Type GIB, or approved equal.
- G. Conduit Sealants:
 - 1. Fire Retardant Types: Fire stop material shall be reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL Classification 35L4 or as specified on the Drawings.

PART 3 - EXECUTION

3.01 CONDUIT, RACEWAY AND FITTING INSTALLATION:

- A. For conduit runs exposed to weather provide rigid metal (GRS).
- B. For conduit run underground, in concrete or masonry block wall and under concrete slabs, install minimum $\frac{3}{4}$ " size nonmetallic (PVC) with PVC elbows. Where conduits transition from underground or under slab to above grade install wrapped rigid metal (GRS) elbows and risers.
- C. For conduit runs concealed in steel or wood framed walls or in ceiling spaces or exposed in interior spaces above six feet over the finished floor, install EMT.
- D. Flexible metal conduit shall be used only for the connection of recessed lighting fixtures and motor connections unless otherwise noted on the Drawings. Liquid-tight steel flexible conduit shall be used for motor connections.

- E. The minimum size raceway shall be 1/2-inch unless indicated otherwise on the Drawings.
- F. Installation shall comply with the CEC.
- G. From pull point to pull point, the sum of the angles of all of the bends and offset shall not exceed 360 degrees.
- H. Conduit Supports: Properly support all conduits as required by the NEC. Run all conduits concealed except where otherwise shown on the drawings.
 - 1. Exposed Conduits: Support exposed conduits within three feet of any equipment or device and at intervals not exceeding NEC requirements; wherever possible, group conduits together and support on common supports. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps.
 - a. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows. Run all exposed conduits parallel or at right angles to building lines.
 - b. Group exposed conduits together. Arrange such conduits uniformly and neatly.
 - 2. Support all conduits within three feet of any junction box, coupling, bend or fixture.
 - 3. Support conduit risers in shafts with Unistrut Superstrut, or approved equal, channels and straps.
- I. Moisture Seals: Provide in accordance with NEC paragraphs 230-8 and 300-5(g).
- J. Where PVC conduit transitions from underground to above grade, provide rigid steel 90's with risers. Rigid steel shall be half-lap wrapped with 20 mil tape and extend minimum 12" above grade.
- K. Provide a nylon pull cord in each empty raceway.
- L. Provide galvanized rigid steel factory fittings for galvanized rigid steel conduit.
- M. Slope all underground raceways to provide drainage; for example, slope conduit from equipment located inside a building to the pull box or manhole located outside the building.
- N. Conduits shall be blown out and swabbed prior to pulling wires, or installation of pull cord in empty conduits.

END OF SECTION

SECTION 260543
UNDERGROUND DUCTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this section consists of furnishing and installing raceways, and raceway spacers with necessary excavation.

1.02 RELATED WORK:

- A. See the following specification sections for work related to the work of this section.

- 1. 02200 Excavation and Backfill
- 2. 26 05 42 Conduit Raceway and Fittings

1.03 STANDARDS AND CODES:

- A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes.
 - 1. National Electrical Code (NEC) (Latest Revision)
 - 2. California Electrical Code (CEC).
 - 3. Underground Installations CEC - Article 300.5
 - 4. Rigid NonMetallic Conduit CEC - Article 347

PART 2 - PRODUCTS

2.01 RACEWAYS:

- A. As specified in Section 26 05 42 Conduits, Raceways and Fittings.

PART 3 - EXECUTION

3.01 EXCAVATION:

- A. As specified in Section 02200, Excavation and Backfill and as required for the work shown on the Drawings.

3.02 INSTALL RACEWAYS AS INDICATED ON DRAWINGS.

3.03 SAND ENCASEMENT:

- A. As specified in Section 02200 - Excavation and Backfill.

3.04 BACKFILL:

- A. As specified in Section 02200 - Excavation and Backfill.

END OF SECTION

SECTION 260544
IN GRADE PULL BOXES

PART 1 - GENERAL

1.01 DeSCRIPTION OF WORK:

- A. The work of this section consists of providing all labor, supervision, tools, materials, and performing all work necessary to furnish and install pre-cast concrete vaults, and pull boxes with necessary excavation.

1.02 RELATED WORK:

- A. See the following specification sections for work related to the work of this section.

- 1. 02200 Excavation and Backfill.
- 2. 260543 Underground Ducts.

1.03 SUBMITTALS:

- A. As specified in Section 260500 and Division 01.

- 1. Catalog Data: Provide manufacturer's descriptive literature - Pre-cast Vaults, Pull Boxes and Accessories.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

- A. General Requirements:

- 1. Pull boxes for electrical power, controls and other communication circuits shall consist of pre-cast reinforced concrete boxes, extensions' bases, and covers as specified herein and as indicated on the Drawings. Pre-cast units shall be the product of a manufacturer regularly engaged in the manufacture of pre-cast vaults and pull boxes. Acceptable manufacturers are Christy, Utility Vault, Brooks, Associated Concrete or equal.

- B. Construction:

- 1. Pre-cast concrete vaults and pull boxes for electrical power distribution and communication circuits with associated risers and tops shall conform to ASTM C478 and ACI 318. Pull boxes shall be the type noted on the Drawings and shall be constructed in accordance with the applicable details as shown. Tops and walls shall consist of reinforced concrete. Walls and bottom shall be of monolithic

concrete construction. Duct entrances and windows shall be located near the corners of structures to facilitate cable racking.

C. Covers:

1. The word "ELECTRICAL" shall be cast in the top face of all electrical cable boxes. The word "Signal" or "Fire Alarm" shall be cast in the top of the boxes utilized for these systems.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install pull boxes where required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not shown on the Drawings.
- B. Pre-cast pull boxes shall be installed approximately where indicated on the Drawings. The exact location of each pull box shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. All cable boxes and secondary pull boxes shall be installed with a minimum of 6-inch thick crushed rock or sand bedding.
- C. Paved areas - Vaults and pull boxes located in areas to be paved shall be installed such that the top of the cover shall be flush with the finished surface of the paving.
- D. Unpaved Areas - In unpaved areas, the top of vaults and pull box covers shall be approximately 2 inches above finished grade.
- E. Joint Seals - Section joints of pre-cast vaults and pull boxes shall be sealed with compound as recommended by the manufacturer.
- F. Trenching, Backfilling, and Compaction - Trenching, backfilling and compaction shall be as specified in Section 02200 - Excavation and Backfill.

END OF SECTION

SECTION 260923
DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Digital Lighting Controls
2. Relay Panels
3. Emergency Lighting Control (if applicable)

B. Related Sections:

1. Section 262726 - Wiring Devices:] Receptacles
2. Section 265100 –Lighting]
3. [Section [250000 – Integrated Automation] Building integrator shall provide integration of the lighting control system with Building Automation Systems.]
4. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division [01], Specification Sections apply to this Section
5. Electrical Sections, including wiring devices, apply to the work of this Section.

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings
4. Task lighting and receptacle controls
5. Emergency Lighting control (if applicable)

1.02 REFERENCES:

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

B. National Electrical Manufacturers Association (NEMA)

C. Underwriters Laboratories, Inc. (UL)

1. 20 – Plug Load Controls
2. 508– Industrial Controls
3. 916 – Energy Management Equipment.
4. 924 – Emergency Lighting

1.03 SYSTEM DESCRIPTION & OPERATION:

A. The Lighting Control and Automation system as defined under this section covers the following equipment:

1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
2. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
3. Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.
4. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting.
5. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
6. Digital Plug-Load Controllers – Self-configuring, digitally addressable, single relay, plenum-rated application-specific controllers. Selected models include integral current monitoring capabilities.
7. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings.

8. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
9. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded,) to connect multiple DLM local networks for centralized control
10. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
11. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
12. Programming and Configuration software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
13. LMCP Digital Lighting Management Relay Panel – provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).
14. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.04 LIGHTING CONTROL APPLICATIONS:

- A. Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:
 1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
 2. Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.

3. Task Lighting / Plug Loads – Provide automatic shut off of non-essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide Automatic-ON of plug loads whenever spaces are occupied. For spaces with multiple occupants a single shut off consistent with the overhead lighting may be used for the area.
4. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
 - a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
 - b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
 - c. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.
 - d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.
5. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.05 SUBMITTALS:

- A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- B. Shop Drawings:
 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 2. Show exact location of all digital devices and part numbers, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.
2. Prove that the sensor is suitable for the proposed application.

1.06 QUALITY ASSURANCE:

A. Manufacturer: Minimum [10] years' experience in manufacture of lighting controls.

1.07 PROJECT CONDITIONS:

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.08 WARRANTY:

A. Provide a five-year limited manufacturer's warranty on all room control devices and panels.

1.09 MAINTENANCE:

A. Spare Parts:

1. Provide spares of each product to be used for maintenance as listed below:
 - a. Provide one of each type of room controller, switch, plug load controller and sensor on the project.

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

A. Acceptable Manufacturer:

1. WattStopper
 - a. System: Digital Lighting Management (DLM)

2. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior approval with specified requirements of this section, of the following:

- a. Approved equal.

B. Substitutions:

1. This specification is based on products from WattStopper, Santa Clara, CA. Complete information on any other system proposed as a substitute must be submitted in writing for approval after bid and assorted cost saving. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety. All deviations from this specification must be listed and individually signed off by the consultant.

2.02 DIGITAL LIGHTING CONTROLS:

- A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

2.03 DIGITAL WALL SWITCH OCCUPANCY SENSORS:

- A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.
- B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1-minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 2. Programmable control functionality including:

- a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - (1) Ultrasonic and Passive Infrared
 - (2) Ultrasonic or Passive Infrared
 - (3) Ultrasonic only
 - (4) Passive Infrared only
3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
4. Two RJ-45 ports for connection to DLM local network.
5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
6. Device Status LEDs including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
8. Assignment of local buttons to specific loads within the room without wiring or special tools
9. Manual override of controlled loads.
10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.

- C. BACnet object information shall be available for the following objects:
1. Detection state
 2. Occupancy sensor time delay
 3. Occupancy sensor sensitivity, PIR and Ultrasonic
 4. Button state
 5. Switch lock control
 6. Switch lock status
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room controller, shall operate in the following sequence as a factory default:
1. Left button
 - a. Press and release - Turn load on
 - b. Press and hold - Raise dimming load
 2. Right button
 - a. Press and release - Turn load off
 - b. Press and hold - Lower dimming load
- G. Low voltage momentary pushbuttons shall include the following features:
1. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 2. The following button attributes may be changed or selected using a wireless configuration tool:
 - a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).

- b. Individual button function may be configured to Toggle, On only or Off only.
 - c. Individual scenes may be locked to prevent unauthorized change.
 - d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 - e. Ramp rate may be adjusted for each dimmer switch.
 - f. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- H. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening. Contractor shall coordinate device finish with [Architect] [Owner].

2.04 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR:

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 - 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1-minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 - 2. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.

- c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - (1) Ultrasonic and Passive Infrared
 - (2) Ultrasonic or Passive Infrared
 - (3) Ultrasonic only
 - (4) Passive Infrared only
- 3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
- 4. One or two RJ-45 port(s) for connection to DLM local network.
- 5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
- 6. Device Status LEDs, which may be disabled for selected applications, including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
- 7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
- 8. Manual override of controlled loads.
- 9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- C. BACnet object information shall be available for the following objects:
 - 1. Detection state
 - 2. Occupancy sensor time delay
 - 3. Occupancy sensor sensitivity, PIR and Ultrasonic

- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.05 DIGITAL WALL SWITCHES:

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configurations. Wall switches shall include the following features:
 - 1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 - 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 - 3. Configuration LED on each switch that blinks to indicate data transmission.
 - 4. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 - 5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
 - 6. Programmable control functionality including:
 - a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
 - b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
 - 7. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. BACnet object information shall be available for the following objects:
 - 1. Button state

2. Switch lock control
 3. Switch lock status
- C. Two RJ-45 ports for connection to DLM local network.
- D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
- E. The following switch attributes may be changed or selected using a wireless configuration tool:
1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
- F. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening. Contractor shall coordinate device finish with [Architect] [Owner].

2.06 HANDHELD REMOTE CONTROLS:

- A. Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching or dimming control. Remote controls shall include the following features:
1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.
 2. LED on each button confirms button press.
 3. Load buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
 4. Inactivity timeout to save battery life.
- B. A wall mount holster and mounting hardware shall be included with each remote control

C. WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105.

2.07 DIGITAL PARTITION CONTROLS:

- A. Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors.
- B. Four-button low voltage pushbutton switch for manual control.
 - 1. Two-way infrared (IR) transceiver for use with configuration remote control.
 - 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 - 3. Configuration LED on each switch that blinks to indicate data transmission.
 - 4. Each button represents one wall; Green button LED indicates status.
 - 5. Two RJ-45 ports for connection to DLM local network.
 - 6. WattStopper part number: LMPS-104. Available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening.
- C. Contact closure interface for automatic control via input from limit switches on movable walls (by others).
 - 1. Operates on Class 2 power supplied by DLM local network.
 - 2. Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
 - a. Input max. sink/source current: 1-5mA
 - b. Logic input signal voltage High: >18VDC
 - c. Logic input signal voltage Low: <2VDC
 - 3. Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
 - 4. Two RJ-45 ports for connection to DLM local network.
 - 5. WattStopper part number: LMIO-102

2.08 DIGITAL DAYLIGHTING SENSORS:

- A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load

type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.

1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
3. Dual loop sensors measure both ambient and incoming daylight in the space to ensure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 footcandles (fc).
3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.

10. Configuration LED status light on device that blinks to indicate data transmission.
 11. Status LED indicates test mode, override mode and load binding.
 12. Recessed switch on device to turn controlled load(s) ON and OFF.
 13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
 - a. Light level
 - b. Day and night setpoints
 - c. Off time delay
 - d. On and off setpoints
 - e. Up to three zone setpoints
 - f. Operating mode – on/off, bi-level, tri-level or dimming
 14. One RJ-45 port for connection to DLM local network.
 15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
 16. Any load or group of loads in the room can be assigned to a daylighting zone
 17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
 18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
- C. Closed loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
 2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.

3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
 4. WattStopper Product Number: LMLS-400, LMLS-400-L.
- D. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.
 2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate dead band between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
 3. Each of the three discrete daylight zones can include any non-overlapping group of loads in the room.
 4. WattStopper Product Number: LMLS-500, LMLS-500-L.
- E. Dual loop digital photosensors shall include the following additional features:
1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from sources outside of this con
 2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60-degree angle, cutting off the unwanted light from the interior of the room.
 3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate dead band between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.
 4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
 5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.

6. Device must include extendable mounting arm to properly position sensor within a skylight well.
7. WattStopper product number LMLS-600

2.09 DIGITAL ROOM CONTROLLERS AND PLUG-LOAD CONTROLLERS:

- A. Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
 1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
 3. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.
 4. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
 5. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
 6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
 - a. Turn on to 100%
 - b. Remain off
 - c. Turn on to last level

7. Each load shall be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 8. Manual-on/Auto-off (Follow off only)
 9. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
 10. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Electrical current
 - c. Total watts per controller
 - d. Schedule state – normal or after-hours
 - e. Demand response control and cap level
 - f. Room occupancy status
 - g. Total room lighting and plug loads watts
 - h. Total room watts/sq. ft
 - i. Force on/off all loads
 11. UL 2043 plenum rated
 12. Manual override and LED indication for each load
 13. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277-volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347-volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.
 14. Zero cross circuitry for each load
 15. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. On/Off Room Controllers shall include:
1. One or two relay configurations

2. Efficient 150 mA switching power supply
 3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
 4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
 2. Multiple relay configurations
 - a. One, two or three relays (LMRC-21x series)
 - b. One or two relays (LMRC-22x series)
 3. Efficient 250 mA switching power supply
 4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
 5. One dimming output per relay
 - a. 0-10V Dimming - Where indicated, one 0-10-volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10-volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
 - b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
 - c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
 - d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel.
 - g. Devices that set calibration or trim levels per controller are not acceptable.
 - h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After-Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After-Hours events.
7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
8. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
9. Override button for each load provides the following functions:
 - a. Press and release for on/off control
 - b. Press and hold for dimming control
10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222

D. Plug Load Room Controllers shall include:

1. One relay configuration with additional connection for unswitched load
2. Configurable additive time delay to extend plug load time delay beyond occupancy sensor time delay (e.g. a 10-minute additive delay in a space with a 20-minute occupancy sensor delay ensures that plug loads turn off 30 minutes after the space is vacated).
3. Factory default operation is Auto-on/Auto-off, based on occupancy
4. Real time current monitoring of both switched and un-switched load (LMPL-201 only)
5. Efficient switching power supply
 - a. 150mA (LMPL-101)
 - b. 250mA (LMPL-201)
6. RJ-45 DLM local network ports
 - a. Three RJ-45 ports (LMPL-101)

- b. Four RJ-45 ports (LMPL-201)

7. WattStopper product numbers: LMPL-101, LMPL-201.

2.10 DLM LOCAL NETWORK (ROOM NETWORK):

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
- B. Features of the DLM local network include:
 - 1. Plug n' Go® automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 - 2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
 - 3. Push n' Learn® configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 - 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
- C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
- D. If manufacturer's pre-terminated Cat 5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.
- E. WattStopper Product Number: LMRJ-Series

2.11 DLM SEGMENT NETWORK (ROOM TO ROOM NETWORK):

- A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.
 - 1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.

2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate “in” and “out” terminations, for segment network connections.
3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.
5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer’s specific requirements.
6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.

B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB

2.12 CONFIGURATION TOOLS:

- A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:
 1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 3. Must be able to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number.
 4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.

6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
8. Verify status of building level network devices.

C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.13 NETWORK BRIDGE:

- A. The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.
 1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.
 2. Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
 3. The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. BACnet objects will be created for the addition or replacement of any given in-room DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:
 - a. Read/write the normal or after-hours schedule state for the room
 - b. Read the **detection** state of each occupancy sensor
 - c. Read the aggregate occupancy state of the room
 - d. Read/write the on/Off state of loads
 - e. Read/write the dimmed light level of loads
 - f. Read the button states of switches

- g. Read total current in amps, and total power in watts through the room controller
- h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
- i. Activate a preset scene for the room
- j. Read/write daylight sensor fade time and day and night setpoints
- k. Read the current light level, in foot-candles, from interior and exterior photosensors and photocells
- l. Set daylight sensor operating mode
- m. Read/write wall switch lock status
- n. Read watts per square foot for the entire controlled room
- o. Write maximum light level per load for demand response mode
- p. Read/write activation of demand response mode for the room
- q. Activate/restore demand response mode for the room

B. WattStopper product numbers: LMBC-300

2.14 SEGMENT MANAGER:

- A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256-bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).
- B. Each segment manager shall have integral support for at least three segment and format networks. Segment networks may alternately be connected to the segment manger via external routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.
- C. Operational features of the Segment Manager shall include the following:
 - 1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
 - 2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. Shall not require installation of any lighting control software to an end-user PC.

3. Log in security capable of restricting some users to view-only or other limited operations.
 4. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
 5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
 6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after-hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
 7. Ability to set up schedules for rooms and panels, view and override current status of panel channels and relays, and assign relays to groups. Schedules shall automatically set controlled zones or areas to either a normal hour or after-hours mode of operation. Support for a minimum of 100 unique schedules, each with up to four-time events per day. Support for annual schedules, holiday schedules and unique date-bound schedules.
 8. Ability to group rooms and loads for common control by schedules, switches or network commands.
 9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.
 10. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control.
 11. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.
- D. Segment Manager shall support multiple DLM rooms as follows:
1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).
 2. Support up to 300 network bridges and 2,200 digitals in room devices, connected via network routers and switches (LMSM-6E).

- E. WattStopper Product Numbers: LMSM-3E, LMSM-6E, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16.

2.15 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE:

- A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

1. Additional parameters exposed through this method include but are not limited to:
 - a. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
 - b. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after-hours modes. Modes include: No Action, Follow Off Only, Follow on Only, follow on and Off, Follow on Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, follow on and Off with Blink Warn Grace Time.
 - c. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
 - d. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
 - e. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
 - f. Load control polarity reversal so that on events turn loads off and vice versa.
 - g. Per-load DR (demand response) shed level in units of percent.
 - h. Load output pulse mode in increments of 1second.
 - i. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered on of switched loads in response to a dimmer.
2. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
 - a. Device list report: All devices in a project listed by type.
 - b. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.

- c. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
 - d. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
 - e. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
 - f. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
 - g. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.
3. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
- a. Set, copy/paste an entire project site of sensor time delays.
 - b. Set, copy/paste an entire project site of sensor sensitivity settings.
 - c. Search based on room name and text labels.
 - d. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
 - e. Filter by parameter value to search for product with specific configurations.
4. Network-wide firmware upgrading remotely via the BACnet/IP network.
- a. Mass firmware update of entire rooms.
 - b. Mass firmware update of specifically selected rooms or areas.
 - c. Mass firmware upgrade of specific products.

B. WattStopper Product Number: LMCS-100, LMCI-100

2.16 EMERGENCY LIGHTING CONTROL DEVICES:

- A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
- 1. 120/277 volts, 50/60 Hz, 20-amp ballast rating

2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 – EXECUTION

3.01 PRE-INSTALLATION MEETING:

- A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
 1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
 2. Review the specifications for low voltage control wiring and termination.
 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 4. Discuss requirements for integration with other trades.

3.02 CONTRACTOR INSTALLATION AND SERVICES:

- A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.
- B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.
- C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.
- D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
 1. Adjust time delay so that controlled area remains lighted while occupied.

- E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

3.03 FACTORY SERVICES:

- A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.
- C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.04 COMMISSIONING SUPPORT SERVICES:

- A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.
- B. The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

3.05 ACCEPTANCE TESTING SUPPORT SERVICES:

- A. On all California projects, a certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Manufacturer should include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. It will be the CLCATT's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the CLCATT with this task.

3.06 LIGHTING CONTROL INSTALLATION CERTIFICATE REQUIREMENTS:

- A. When certification is required by Title 24, Part 1, Section 10-103-A, the acceptance testing specified by Section 130.4 shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT) employed or hired by the electrical contractor. If the CLCATT is operating as an employee, the CLCATT shall be employed by a Certified Lighting Controls Acceptance Employer. The CLCATT shall disclose on the Certificate of Acceptance a valid CLCATT certification identification number issued by an approved Acceptance Test Technician Provider. The CLCATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.
- B. Lighting Control Installation Certificate Requirements. To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with Section 10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary overcurrent protection panel, interlocked lighting system, lighting Power Adjustment Factor, or additional wattage available for videoconference studio, in accordance with the following requirements, as applicable:
 - 1. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of Section 110.9; and complies with Reference Nonresidential Appendix NA7.7.1.
 - 2. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5, 140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.
 - 3. Certification that line-voltage track lighting current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.3.
 - 4. Certification that line-voltage track lighting supplemental overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.4.

5. Certification that interlocked lighting systems used to serve an approved area comply with Section 140.6(a)1; and comply with Reference Nonresidential Appendix NA7.7.5.
6. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section 140.6(a)2; and comply with Reference Nonresidential Appendix NA7.7.6.
7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)Gvii; and complies with Reference Nonresidential Appendix NA 7.7.7.

END OF SECTION 26 09 23

SECTION 260924
DIGITAL LIGHTING MANAGEMENT RELAY CONTROL PANEL

PART 1 - GENERAL

1.01 INTRODUCTION:

- A. The work covered in this section is subject to the requirements in the General Conditions of division 01 and all sections of division 26 of the Specifications. Contractor shall coordinate the work in this section with the trades covered in other sections of the specification to provide a complete and operable system.

1.02 SYSTEM DESCRIPTION:

- A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an integrated, energy saving lighting control system including Lighting Control Panels, Occupancy Sensors, and Daylighting Controls from a single supplier. Contractor is responsible for confirming that the panels and sensors interoperate as a single system. When centralized line-voltage mounting or management is required, relay panel platforms being considered must have sufficient configuration flexibility to implement room-level code compliant controls sequences including, but not limited, to those referenced in section **2.01** of this specification.

1.03 SUBMITTALS:

- A. Submit manufacturer's data on lighting control system and components including shop drawings, detailed wiring diagrams, and cut sheets as required under related specification sections.
- B. Shop Drawings:
 - 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 - 2. Show exact location of all digital devices and part numbers, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
 - 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
 - 4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

1.04 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Comply with NEC, NEMA, and FCC requirements for Class A applications.
- C. UL Approvals: Relay panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Emergency relay panels shall be co-listed under UL 924 Emergency Lighting Equipment.

1.05 MANUFACTURERS:

- A. This specification is based on products from WattStopper, Santa Clara, CA. Complete information on any other system proposed as a substitute must be submitted in writing for approval after bid and assorted cost saving. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety. All deviations from this specification must be listed and individually signed off by the consultant.

PART 2 – PRODUCTS

2.01 LIGHTING CONTROL PANELS:

- A. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:
 - 1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 – 8 relays, 1 – 24 relays and 6 four-pole contactors, or 1 – 48 relays and 12 four-pole contactors.
 - 2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
 - 3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
 - a. Removable, plug-in terminal blocks with screwless connections for all low voltage terminations.
 - b. Individual terminal block, override pushbutton, and LED status light for each relay.

- c. Direct wired switch inputs associated with each relay and group channel shall support two-wire, momentary or maintained contact switches.
- d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches, digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs, digital IO modules capable of receiving momentary or maintained contact closure inputs, digital photocell modules, and digital occupancy sensors.
- e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
- f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
- g. Group, channel, and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any group of relays can be associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override pushbuttons and LED displays for channels 1-9 or a handheld IR programmer for channels 1-99.
- h. Relay group status for each channel shall be provided through red LED indicators for groups 1-9 and via BACnet for groups 1-99. Solid red indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.
- i. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
 - (1) Electrical:
 - (a) 30-amp ballast at 277V
 - (b) 20-amp tungsten at 120V
 - (c) 1.5 HP motor at 120V
 - (d) Relays shall be specifically UL listed for control of plug loads
 - (2) Mechanical:
 - (a) Individually replaceable, 1/2" KO mounting with removable Class 2 wire harness.
 - (b) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
 - (c) Dual line and load terminals each support two #14 – #12 solid or stranded conductors.
 - (d) Tested to 300,000 mechanical on/off cycles.
 - (3) Isolated low voltage contacts provide for true relay status feedback and pilot light indication.

4. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
5. Lighting control panels shall be WattStopper model LMCP8, LMCP24 or LMCP48 as shown on the plans.

2.02 BACNET® BASED DIGITAL COMMUNICATIONS:

- A. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 master/slave token passing-based using the BACnet® protocol.
 1. The panel shall have provision for an individual BACnet device ID. The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
 2. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
 3. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
 4. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.
 5. The 99 channel groups associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hour's mode. Commanding 0 or NULL shall put the relays into the afterhours mode.
 6. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:
 - a. Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.
 - b. Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/afterhours schedule control.
 - c. Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.

- d. Analog value objects in the instance range of 1 – 64 (one per relay) shall assign relays to channel groups in the range of 1 – 99.
 - e. Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.
 - f. Analog value objects in the instance range of 201 – 299 (one per channel) shall assign an after-hours time delay value to the channel in the range of 1 – 240 minutes.
 - g. Multi-state value objects in the instance range of 1 – 99 (one per channel) shall provide the state of the relays assigned to the channel. Valid states shall be ALL ON, MIXED, BLINK, and ALL OFF.
7. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.
 8. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa. (<http://www.bacnet.org/Addenda/Add-135-2010aa.pdf>)
 9. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.
 10. Lockout of all digital switch buttons connected to a given panel shall be commandable via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.
 11. Lighting control accessory devices connected to the panel shall be represented via BACnet objects including but not limited to the following:
 - a. Digital occupancy sensor detection states shall be readable as BI objects ranging from BI1-96.
 - b. Digital occupancy sensor configuration parameters shall each be accessible as BACnet objects when applicable to a given product.
 - (1) Occupancy sensor time delay in minutes shall be writeable via AV101-196.
 - (2) Occupancy sensor passive infrared (PIR) sensitivity percentage shall be writeable via AV201-296.
 - (3) Occupancy sensor ultrasonic (US) sensitivity percentage shall be writeable via AV301-396.

- c. Digital switch buttons shall be readable and writeable as BI objects ranging from BI101 – 9608.
- d. Digital daylight sensors foot-candle readings shall be readable as follows:
 - (1) Analog 0-5V/0-10V sensors connected to a digital input module shall be represented as AI1-96.
 - (2) Digital closed loop sensors shall be represented as AI4001-4096.
 - (3) Digital open loop sensors shall be represented as AI5001-5096.
 - (4) Digital dual loop sensors shall be represented as follows:
 - (a) The upward facing open loop sensor shall be represented as AI6001-6096.
 - (b) The downward facing closed loop sensor shall be represented as AI6101-6196.
- e. Digital daylight sensor configuration shall be exposed as BACnet objects as follows:
 - (1) Digital closed loop sensors shall be represented as follows:
 - (a) Daylight Sensor Day Setpoint (ftcd) AV4201-4296.
 - (b) Daylight Sensor Night Setpoint (ftcd) AV4301-4396.
 - (c) Daylight Sensor Off Setpoint Delay (minutes) AV4401-4496.
 - (d) Daylight Sensor on Setpoint (ftcd) AV4501-4596.
 - (e) Daylight Sensor Off Setpoint (ftcd) AV4601-4696.

2.03 USER INTERFACE:

- A. Each lighting control panel system shall be supplied with at least (1) handheld IR remote programming interface consisting of a keypad and associated OLED display screen. The user interface shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following functions as a minimum:
 - 1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
 - 2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.

3. Program up to 254 separate scheduled events. Events shall occur on seven-day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven-day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.
5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
7. An additional handheld IR remote may optionally be specified to be permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as seen fit by the end user's representative.

2.04 DIGITAL NETWORK SWITCHES:

- A. Provide digital wall switches with 1, 2, 3, 4, or 8 buttons, in the colors indicated on the plans. Switches shall connect to the panel via standard Cat 5e cable with RJ-45 terminations. Digital wall switches shall have the following features:
 1. Available colors: white, ivory, light almond, grey or black.
 2. Single gang device shall fit standard decorator opening and use standard wall plates.
 3. LED indicator on each button for status and locator function.
 4. Concealed configuration button with LED indicator for binding buttons to relays, no software or computer shall be required.
 5. Infrared window for use with handheld two-way wireless configuration tool,
 6. Selectable function mode per button shall be momentary toggle (on/off), on only, or off only.
 7. Removable button assembly for field color change or substitution of engraved buttons.

8. Two RJ-45 ports for connection to panel or other switches and/or occupancy sensors.
9. Open topology digital network via Cat 5e wire.
10. Digital switches shall be WattStopper LMSW series as indicated on the plans.
11. Digital switch buttons shall be able to control groups and group actions shall be system global such that any digital switch station can affect the state of relays present in up to (12) twelve panels networked together via BACnet.

2.05 DIGITAL OCCUPANCY SENSORS:

- A. Provide digital occupancy sensors to control relays in locations as shown on the plans. Sensors shall be either passive infrared, ultrasonic, or dual technology as indicated. Sensors shall be either ceiling or wall mounted and connect to the panel using Cat 5e cable with RJ-45 terminations. Digital occupancy sensors shall have the following features:
 1. Setup and calibration shall be digital and precisely repeatable from sensor to sensor.
 2. User interface with pushbuttons and illuminated LCD screen for setup and calibration.
 3. Ladder-free setup and calibration with optional handheld two-way infrared commissioning tool.
 4. Sensitivity, 0 – 100% in 10% increments.
 5. Time delay, 1 – 30 minutes in 1-minute increments.
 6. Test mode with five-second time delay for simplified walk testing.
 7. Digital occupancy sensors shall be WattStopper LM series as indicated on the plans.
 8. Digital occupancy sensors shall be able to control groups and group actions shall be system global such that any digital occupancy sensor can affect the state of relays present in up to (12) twelve panels networked together via BACnet.

2.06 DIGITAL NETWORK CLOCK:

- A. Each panel shall include a digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.

1. The clock capability of each panel shall support all of the energy saving features required of ASHRAE 90.1 - 2001, IECC 2003, as well as all state and local energy codes.
2. The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery backup for the clock function and EEPROM for program retention. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
3. The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:
 - a. Scheduled ON / OFF
 - b. Manual ON / Scheduled OFF
 - c. Astro ON / OFF (or Photo ON / OFF)
 - d. Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)
4. The user interface shall be a portable IR handheld remote control capable of programming any panel in the system.
5. The clock capability of each panel shall employ non-volatile memory and shall retains user programming and time for a minimum of 10 years.
6. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

2.07 APPLICATION SEQUENCE OF OPERATIONS SUPPORT:

- A. The lighting control panel shall support relay behavior parameter configuration of such an extent as to allow digital switch, digital occupancy sensor, digital automatic photocells, and scheduled events to seamlessly implement, at a minimum, the following operational sequences:
 1. Title 24 operation requiring Manual On 50%, Automatic on 100%, automatic shut-off on vacancy shall be able to be implemented by using any two relays in a given panel. The sensor(s) for that space will be bound to both relays, each of which shall be given an independent operation mode of Auto on and Manual On respectively, such that on occupancy only 50% of the lighting activates. The digital switch stations for the space, having at minimum two buttons, shall be bound to both relays such that at least one button controls only 50% of the lights and at least one separate button controls only the remaining 50% of the lights allowing for independent zone control. The occupancy sensor(s) action on vacancy shall be to

turn off both relays. Configuration of this operational sequence shall not require special software or tools and shall be accomplished using only the handheld IR remote control.

2. Open office spaces that must turn on automatically by sensor during the Normal Hours operating period and stay on until a scheduled sweep of the space on transition to the After Hours operating shall use the handheld IR remote control to create a group of the relays for that space with a group parameter type that automatically adjust the Normal Hours and After-Hours run-time parameters to the required values. Relay operation during Normal Hours shall therefore be for a relay to turn on when its respective occupancy sensor(s) detect motion and to stay on until the After Hours sweep time. Once the After Hours sweep occurs, all relays shall operate as automatic ON/OFF in response to their respective sensors. Systems that require individual relay parameters to be adjusted on a per relay basis are not acceptable.
3. Private office spaces that must operate as manual on/manual off during Normal Hours and automatic on/automatic off during After Hours with no sweep off on transition to After Hours operation shall use the handheld IR remote control to create a group of the relays that must follow that operational sequence using a group parameter type that automatically adjusts the Normal Hours and After-Hours run-time parameters to the required values. Relay operation during Normal Hours shall therefore be for a relay to turn on only when a digital switch station button bound to it is activated and to turn off automatically in response to the vacancy signal of all occupancy sensors bound to it. Systems that require individual relay parameters to be adjusted on a per relay basis are not acceptable.

2.08 SCHEDULE, GROUP, AND PHOTOCCELL CONTROL OF RELAYS:

- A. The lighting control panel shall support schedule, group, and photocell control functions via the network as configured in the optional Segment Manager controller or building automation system. The lighting control panel shall be fully compatible with building automation systems that are BACnet compliant. See related specification sections for additional information on interfacing the lighting control panel(s) to the building automation system.

2.09 BROWSER-BASED PROGRAMMING AND CONTROL:

- A. The relay panel system shall be capable of use in conjunction with an optional digital web-based appliance such as the WattStopper Segment Manager. Such a controller shall be a compact controller capable of hosting the schedule, photocell, and group relay control functions for a network of LMCP series lighting control panels. The segment manager shall provide the following features:
 1. Provision for 1 to 3 separate network segments to facilitate efficient network wire routing.
 2. Compact housing with screw tab mounts for surface installation and integral DIN rail mounting slot for NEMA 1 installation in the LMSM-ENC1 enclosure.

3. Web browser-based user interface; shall not require the installation of any lighting control software.
4. User interface accessible form most smart phone browsers when Internet connected.
5. Login security access control restricting some users to view-only or other limited operations.
6. Automatic discovery of the lighting control panels.
7. Familiar navigation-tree-based browsing to individual lighting control panels.
8. View/override current status of channels and relays.
9. Assign relays to groups.
10. Create and run schedules:
 - a. Normal hours/afterhours schedules for channels.
 - b. On/off schedules for relays.
 - c. Support for a minimum of 100 unique schedules, each with up to four-time events per day.
 - d. Support annual schedules, holiday schedules and unique date-bound schedules.
11. Ethernet connectivity for user access via direct-wired connection, LAN/WAN, or Internet connection.
12. BACnet IP connectivity for connection to building automation systems.
13. Segment manager shall be WattStopper LMSM-201 with one network segment or LMSM-603 with support for three network segments.
14. Support for additional segments beyond 3 must be possible via the addition of standard BACnet MS/TP routers. The use of gateway devices or other proprietary protocols for system expansion is not acceptable.

PART 3 – EXECUTION

3.01 SUPPORT SERVICES:

A. System Start Up and Commissioning

1. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of the lighting control panels, switches, and occupancy sensors.
2. The technician shall provide training on the lighting control features of the system and shall verify that the panel(s) is communicating with the building automation system.
3. The technician shall provide 1 – day of additional training and configuration of operation 60 days after final acceptance of project by owner.
4. The system integrator or BAS vendor shall be responsible for all integration including the mapping of BACnet objects into the BAS logic, schedules and graphics.

3.02 ACCEPTANCE TESTING SUPPORT SERVICES:

- A. On all California projects, a certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Manufacturer should include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. It will be the CLCATT's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the CLCATT with this task.

3.03 LIGHTING CONTROL INSTALLATION CERTIFICATE REQUIREMENTS:

- A. When certification is required by Title 24, Part 1, Section 10-103-A, the acceptance testing specified by Section 130.4 shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT) employed or hired by the electrical contractor. If the CLCATT is operating as an employee, the CLCATT shall be employed by a Certified Lighting Controls Acceptance Employer. The CLCATT shall disclose on the Certificate of Acceptance a valid CLCATT certification identification number issued by an approved Acceptance Test Technician Provider. The CLCATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.
- B. Lighting Control Installation Certificate Requirements. To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with Section 10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary overcurrent protection panel, interlocked lighting system, lighting Power Adjustment Factor, or additional wattage available for videoconference studio, in accordance with the following requirements, as applicable:
 1. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of Section 110.9; and complies with Reference Nonresidential Appendix NA7.7.1.

2. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5, 140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.
3. Certification that line-voltage track lighting current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0©; and comply with Reference Nonresidential Appendix NA7.7.3.
4. Certification that line-voltage track lighting supplemental overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130. (c); and comply with Reference Nonresidential Appendix NA7.7.4.
5. Certification that interlocked lighting systems used to serve an approved area comply with Section 140.6(a)1; and comply with Reference Nonresidential Appendix NA7.7.5.
6. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section 140.6(a)2; and comply with Reference Nonresidential Appendix NA7.7.6.
7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)Gvii; and complies with Reference Nonresidential Appendix NA 7.7.7.

END OF SECTION 26 09 24

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SECTION 262200
Transformers

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this section consists of providing dry type transformers as shown on Drawings and as described in this section.

1.02 RELATED WORK:

- A. See the following specification sections for work related to the work in this section.
 - 1. 26 05 19 Line Voltage Wire and Cable.
 - 2. 26 05 26 Grounding.

1.03 SUBMITTALS: IN ACCORDANCE WITH DIVISION 1.

- A. Shop Drawings: Submit manufacturer's name and nameplate data as follows:
 - 1. KVA rating.
 - 2. Nominal primary voltage.
 - 3. Tap voltages.
 - 4. Nominal secondary voltage.
 - 5. Percent impedance.
 - 6. Weight.
 - 7. Physical dimensions and mounting requirements.
- B. Submit manufacturer's no-load loss value for transformer.
- C. Operation and Maintenance Data: Submit the manufacturer's operation and maintenance data in accordance with Division 1. Copies of the factory and field test reports shall be included in this submittal.

1.04 FACTORY TESTING:

- A. Tests on transformers shall include the manufacturer's standard tests, including winding resistance, ratio, polarity, phase relation, no-load loss, impedance, full load losses, and dielectric tests. Certified copies shall show compliance with all referenced standards.

PART 2 - PRODUCTS:

2.01 DRY TYPE TRANSFORMER:

- A. Unless otherwise noted on the Drawings, general purpose transformers for supplying lighting and small power loads shall be dry type, two winding, 60 Hertz, aluminum windings, temperature rise not exceeding 150°C under full load in an ambient of 40°C, with Class H 220°C insulation. Capacity rating, number of phases and voltages shall be as shown on the Drawings. Transformer shall comply with all applicable provisions of NEMA Standard ST20 and shall have NEMA Standard taps. Transformers rated below 15 KVA shall have two (2) 5% full capacity taps below rated primary volts and transformers rated 15 KVA and above shall have six (6) 2-1/2% full capacity taps, two above the four below nominal voltage Terminal compartment shall have a temperature rise not to exceed 35°C. Provide unit UL listed for indoor/outdoor mounting. Provide dry-type transformer as manufactured by Square D, Siemens, General Electric Company or approved equal.
- B. Transformers shall be low loss type with minimum efficiencies per NEMA TP-1 when operated at 35% of full load capacity. Efficiency shall be tested in accordance with NEMA TP-2.
- C. Transformers installed outdoors shall be NEMA 3R, unless otherwise noted on the Drawings.
- D. Transformer sound levels shall not exceed the following values;
 - 1. 0-9 KVA 40 decibels
 - 2. 10-50 KVA 45 decibels
 - 3. 51-150KVA 50 decibels
 - 4. 151-300KVA 55 decibels
 - 5. 301-500KVA 60 decibels

PART 3 - EXECUTION

3.01 TRANSFORMER INSTALLATION:

- A. Transformer shall be where indicated on the Drawings. Indoor transformers shall have code and manufacturers recommended clearances from adjacent walls. In no case should this clearance be less than six inches.
- B. Transformer shall be connected with flexible liquid tight metallic conduit to prevent the transmission of sound through the conduit system. All transformers shall be installed on resilient vibration-isolating mounting pads.
- C. Transformer neutral grounding shall be sized in accordance with requirements for separately derived systems and shall be connected to the nearest cold-water pipe with supplementary driven ground. Ground rod and connections shall be as detailed in Section 260526.

3.02 FIELD TESTS:

- A. Insulation-Resistance Tests: 480-volt windings shall be tested with a 1000-volt megohm meter; 208 or 240 shall be tested with a 500-volt megohm meter. All tests shall be applied for not less than 5 minutes and until three consecutive readings, one-minute part, are obtain. Readings shall be recorded every 30 seconds for the first two minutes and every minute thereafter.
- B. Acceptance: Acceptance with be based on satisfactory completion of the insulation resistance tests.

END OF SECTION

SECTION 26 24 16
PANELBOARDS AND DISTRIBUTION PANELS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this Section consists of providing panelboards and circuit breakers as shown on the Drawings and as described herein.

1.02 RELATED WORK:

- A. See the following specification sections for work related to the work in this Section.
1. 26 05 19 Line Voltage Wire and Cable
 2. 26 05 26 Grounding
 3. 26 28 16 Circuit Breakers

1.03 SUBMITTALS:

- A. Shop Drawings - As specified in Division 01 and Section 26 05 00. For each panelboard and distribution panel furnished under this Contract, submit manufacturer's name, catalog data, and the following information:
1. Panelboard / distribution panel type.
 2. Main bus and terminal connection sizes.
 3. Location of line connections.
 4. Cabinet dimension.
 5. Gutter space.
 6. Gauge of boxes and fronts.
 7. Finish data.
 8. Voltage rating.
 9. Breaker manufacturer, types, trip rating, and interrupting ratings.
 10. When information is available on the Drawings, show breaker circuit numbers and locations along with trip ratings on a panelboard layout.
- B. Single Submittal - A single complete submittal is required for all products covered by this Section.

- C. Closeout Submittals: Submit operation and maintenance data for panelboards and circuit breakers including nameplate data, parts lists, factory and field test reports, recommended maintenance procedures and typewritten as-built panel schedules. Submit in accordance with Division 01.

PART 2 – PRODUCTS

2.01 PANELBOARDS:

- A. General: Lighting and Receptacle Panelboards shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings or, if not shown, 42 circuits. All circuit breakers shall be quick-make, quick-break, thermal-magnetic, bolt-on type (unless otherwise noted on drawings), with 1, 2 or 3 poles as shown, each with a single operating handle. Tandem or piggy-back breakers shall not be used.
- B. Nameplates:
1. Each panelboard shall have a field mounted identifying, rigid, plastic nameplate giving the panel identification as shown on the Drawings.
 2. Each panelboard shall have a manufacturer's nameplate showing the voltage, bus rating, number of phases, frequency and number of wires.
- C. Construction:
1. Door and trim shall be finished to match finish type and color of surrounding wall. Box shall be hot-dip galvanized, and field finished to match the front.
 2. Panelboards and enclosures shall conform to requirements of all relevant codes. Panelboards shall be suitable for use as service equipment.
 3. Panelboards shall be furnished with hinged trim fronts with key latch and a typed directory card and holder. Panelboard circuits shall be arranged with odd numbers on the left and even numbers on the right. Provide weatherproof, NEMA type 3R enclosures for outdoor installation.
- D. Busbars: Panelboard busbars shall be phase sequence type suitable for bolt-on circuit breakers. All busbars shall be copper.
- E. Circuit Breakers: Circuit breakers shall be the molded case type with trip and interrupting ratings as shown on the Drawings.
- F. Manufacturer:
1. Panelboards shall be of the same manufacturer as the switchboard.

2.02 DISTRIBUTION PANELS:

- A. General: Distribution panels shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings. All circuit breakers shall be quick-make, quick-break, thermal-magnetic bolt-on type, with 1, 2 or 3 poles as shown, each with a single operating handle. Tandem or piggy-back breakers shall not be used.
- B. Nameplates:
1. Each distribution panel shall have a field mounted, identifying, rigid, plastic nameplate giving the panel identification as shown on the Drawings.
 2. Each distribution panel shall have a manufacturer's nameplate showing the voltage, bus rating, number of phases, frequency and number of wires.
- C. Construction:
1. Door and trim shall be finished to match color of surrounding wall. Box shall be hot-dip galvanized, field finished to match the front.
 2. Distribution panels and enclosures shall conform to requirements of all relevant codes. Distribution panels shall be suitable for use as service.
 3. Distribution panels shall have a front door with key latch and a typed directory card and permanently attached holder. Adhesive backed holders are not acceptable. Distribution panels circuits shall be arranged with odd numbers on the left and even numbers on the right. Provide weatherproof, NEMA type 3R enclosures for outdoor installation.
- D. Busbars: Distribution panels busbars shall be phase sequence type suitable for bolt-on circuit breakers. All busbars shall be copper, sized for a maximum current density of 1000A psi.
- E. Circuit Breakers:
1. Circuit breakers shall be the molded case type with trip and interrupting ratings as shown on the Drawings.
 2. Circuit breakers equipped with Ground-Fault Equipment Protection shall be capable of the following types of ground-fault protection: residual, source ground return, and modified differential.
 - a. Ground-fault settings for circuit breaker sensor sizes 1200 A or below shall be adjustable from 0.2 to 1.0 times I_n in 0.1 I_n increments. The ground-fault settings for circuit breakers above 1200 A shall be adjustable from 500 to 1200 A.
 3. Circuit breakers with an arc Energy-Reducing Maintenance Switch (ERMS) setting shall be equipped with a separate trip curve to reduce incident energy.
 - a. The ERMS trip curve shall be selected through physical selector. Trip unit [remote indicator light] shall indicate when trip unit is operating in ERMS mode.

- b. Trip unit shall operate in Fast Instantaneous trip mode, 25 to 30 mS, when ERMS trip curve is active.
- c. Engaging/disengaging the ERMS mode or making settings changes to the ERMS settings shall be restricted to authorized personnel by limiting access to such features by padlocks or passwords to ensure safety of the personnel working with the equipment.

F. Manufacturer:

- 4. Distribution panels shall be of the same manufacturer as the switchboard.

PART 3 – EXECUTION

3.01 INSTALLATION: Panelboards and Distribution Panels shall be installed where indicated on the Drawings, and in accordance with the manufacturer's instructions.

3.02 INSTALLATION:

- A. Panelboards and Distribution Panels shall be installed where indicated on the Drawings, and in accordance with the manufacturer's instructions.
- B. Circuit breakers for solidly grounded Wye Electrical Systems of more than 150V to Ground and 1000A or larger shall be equipped with Ground-Fault Equipment Protection.
- C. Circuit breakers 1200A and larger shall be equipped with a separate trip curve for an arc Energy-Reducing Maintenance Switch (ERMS) setting to reduce incident energy.

3.03 MOUNTING:

- D. Panelboards and Distribution Panels shall be mounted with the top of the box 6'-6" above the floor. Panelboards and Distribution Panels shall be plumb within 1/8-inch. The highest breaker operating handle shall not be higher than 72 inches above the floor.

3.04 FIELD TESTS:

- A. Insulation Resistance Tests: Perform insulation resistance tests on circuits with #2 AWG and larger conductors to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall not be connected. Test the insulation with a 500Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.
- B. Grounding: Grounding shall conform to Section 26 05 26.
- C. Continuity: Panelboard and Distribution Panel circuits shall be tested for continuity prior to energizing. Continuity tests shall be conducted using a dc device with a bell or buzzer.

END OF SECTION

SECTION 262726
DEVICES WIRING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this section consists of:

1. Furnishing, installing, and connecting all duplex receptacles complete with wall plates and/or covers, as shown on the Drawings.
2. Furnishing, installing and connecting all light switches complete with wall plates and or handle operators, as shown on the Drawings.

1.02 RELATED WORK:

A. See the following specification sections for work related to the work of this section:

1. 26 05 42 Conduits, Raceways and Fittings.
2. 26 05 19 Line Voltage Wire and Cable.
3. 26 05 33 Junction and Pull Boxes.

1.03 SUBMITTALS: As specified in Section 26 05 00 and Division 01.

- A. Submit manufacturers published descriptive literature properly marked to identify the items to be supplied.
- B. A single complete submittal is required for all products covered by this Section.

PART 2 – PRODUCTS

2.01 RECEPTACLES:

- A. General - Receptacles shall be heavy duty, high abuse, grounding type.
- B. [Tamper Resistant] Duplex Receptacles:
1. Receptacles shall be specification grade, rated 20 ampere, two-pole, 3-wire, 125 volt, NEMA 5-20 configuration, self-grounding with screw terminals. Color shall be as selected by the Architect.
 2. Devices shall have a nylon face, back and side wired.
 3. Manufacturer: Hubbell #DR20 Series [Hubbell #DR20__ TR], Leviton #16352 Series [Leviton # 16352-TRE __ Series].

C. GFCI Receptacles [Tamper Resistant]:

1. Device shall be rated 20 ampere, 2-pole, 3-wire, 120 volts, conforming to NEMA 5-20 configuration. Face shall be nylon composition. Unit shall have an LED type red indicator light, test and reset push buttons. Color shall be as selected by the Architect.
2. GFCI component shall meet UL 943 Class A standards with a tripping time of 1/40 second at 5 milliamperes current unbalance. Operating range shall extend from -31°F to 158°F. Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.
3. Manufacturer: Hubbell #GF20 __ LA Series [Hubbell # GFTR20 __ Series], Leviton #GFNT2 Series [Leviton #GFTR2 Series].

D. Weather Resistant GFCI Receptacles:

1. Device shall be rated 20 ampere, 2-pole, 3-wire, 120 volts, conforming to NEMA 5-20 configuration, Face shall be nylon composition. Unit shall have a LED type red indicator light, test and reset push buttons. Color shall be as selected by the architect.
2. GFCI component shall meet UL 943 Class A standards with a tripping time of 1/40 second at 5 milliamperes current unbalance. Operating range shall extend from -31°F to 158°F. Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.
3. Manufacturer: Hubbell #GFTR20 __ Series, Leviton #GFWR2 Series.

2.02 SWITCHES:

- A. Switches shall be rated 20 amperes to 120/277 volts ac. Units shall be flush mounted, self-grounding, quiet operating rocker devices. Rocker color shall be as selected by the Architect.
1. Manufacturer: Hubbell #DS_20 __ Series, Leviton #5621 Series. See plans for single pole, three way and four-way requirements.
- B. Timed switches: Shall be as designed by Paragon Electric Company # ET2000f or Watt Stopper TS-400 rated for the voltage specified on drawings. Time-out shall be adjustable from 5 minutes up to 12 hours. Unit shall be provided with warning alarm.
- C. Dimmer switches: Switch shall be as specified on drawings, color per architect. Heat fins shall not be removed, where dimmer switches are ganged together, care shall be taken to install correct size backbox to accommodate switches without removing fins.

2.03 Plates:

- A. General - Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform with NEMA WD 1, UL 514 and FS W-P-455A. Plates on finished walls shall be non-metallic or stainless steel. Plates on

unfinished walls and on fittings shall be of zinc plated steel or case metal and shall have rounded corners and beveled edges.

- B. Non-Metallic: Plates shall be plain with beveled edges and shall be nylon or reinforced fiberglass.
- C. Stainless Steel: Plates shall be .040 inches thick with beveled edges and shall be manufactured from No. 430 alloy having a brushed or satin finish.
- D. Cast Metal: Plates shall be cast or malleable iron covers with gaskets so as to be moisture resistant or weatherproof.
- E. Blank Plates: Cover plates for future telephone outlets shall match adjacent device wall plates in appearance and construction.
- F. Weatherproof Plate: Cover plates in wet and damp locations shall have recessed in-use covers, Taymac or equal. Back box shall be suitable for the wall material where it is installed.
- G. Labeling: All switch and receptacle plates shall be labeled on the top portion of the plate with the panelboard and circuit number serving that device. Lettering shall be 3/16" minimum high, black color, on clear Mylar 3/8" tape. Manufactured by P-touch or equal.

PART 3 – EXECUTION

1.01 INSTALLATION OF WIRING DEVICES:

- A. Interior Locations: In finished walls, install each device in a flush mounted box with washers as required to bring the device mounting strap level with the surface of the finished wall. On unfinished walls, surface mount boxes level and plumb.
- B. Mounting Heights: Adjust boxes so that the front edge of the box shall not be farther back from the finished wall plane than 1/4-inch. Adjust boxes so that they do not project beyond the finished wall. Height of device shall be as follows unless otherwise noted on the drawings:
 - 1. Receptacles 15 Inches from finished floor to bottom of box.
 - 2. Toggle Switches 48 Inches from finished floor to top of box.
- C. Receptacles:
 - 1. Ground each receptacle using a grounding conductor, not a yoke or screw contact.
 - 2. Install receptacles with connections spliced to the branch circuit wiring in such a way that removal of the receptacle will not disrupt neutral continuity and branch circuit power will not be lost to other receptacles in the same circuit.

1.02 INSTALLATION OF WALL PLATES:

- A. General - Plates shall match the style of the device and shall be plumb within 1/16-inch of the vertical or horizontal.
- B. Interior Locations, Finished Walls: Install non-metallic plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Do not use oversized plates or sectional plates.
- C. Interior (not wet) Locations, Unfinished Walls: Install stainless steel or cast metal cover plates.
- D. Wet Locations: Install cast metal plates with gaskets on wiring devices in such a manner as to provide a rain tight weatherproof installation. Cover shall be [lockable] outdoor "in use" type.
- E. Future Locations: Install blanking cover plates on all unused outlets.

1.03 TESTS:

- A. Receptacles:
 - 1. After installation of receptacles, energize circuits and test each receptacle to detect lack of ground continuity, reversed polarity, and open neutral condition.

END OF SECTION

SECTION 26 28 16 CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this Section consists of providing circuit breakers as shown on the Drawings and as described herein.

1.02 RELATED WORK: See the following Specification Sections for work related to the work in this Section.

- A. 26 05 00 General Electrical Requirements
- B. 26 24 13 Switchboards
- C. 26 24 16 Panelboards and Distribution Panels

1.03 SUBMITTALS:

- A. Shop Drawings - Submittals shall be in accordance with Section 26 05 00 and Division 01. For each circuit breaker furnished under this Contract, submit manufacturer's name, catalog data, and the following information:
 - 1. Terminal connection sizes.
 - 2. Voltage rating.
 - 3. Breaker manufacturer, types, trip ratings and interrupting ratings.
- B. Single Submittal - A single complete submittal is required for all products covered by this Section.
- C. Closeout Submittals: Submit in accordance with and Section 26 05 00, operation and maintenance data for circuit breakers including nameplate data, parts lists, manufacturer's circuit breaker timer, current, coordination curves, factory and field test reports and recommended maintenance procedures.

PART 2 - PRODUCTS

2.01 CIRCUIT BREAKER: Each circuit breaker shall consist of the following:

- A. A molded case breaker with an over center toggle-type mechanism, providing quick-make, quick-break action. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Multipole circuit breakers shall have variable magnetic trip elements which are set by a single adjustment

to assure uniform tripping characteristics in each pole. Circuit breakers shall be of the bolt-on type unless otherwise noted.

- B. Breaker shall be calibrated for operation in an ambient temperature of 40°C.
- C. Each circuit breaker shall have trip indication by handle position and shall be trip-free.
- D. Three pole breakers shall be common trip.
- E. The circuit breakers shall be constructed to accommodate the supply connection at either end of the circuit breaker. Circuit breaker shall be suitable for mounting and operation in any position.
- F. Breakers shall be rated as shown on Drawings.
- G. Circuit breaker and/or Fuse/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations for use in the end use equipment in which it is installed. Any series rated combination used shall be marked on the end use equipment per CEC section 110-22.
- H. Breakers shall be UL listed. Circuit breakers shall have removable lugs.
- I. Lugs shall be UL listed for copper and aluminum conductors.
- J. Breakers shall be UL listed for installation of mechanical screw type lugs.
- K. Circuit breakers serving HACR rated loads shall be HACR type. Circuit breakers serving other motor loads shall be motor rated.

PART 3 - EXECUTION

3.01 MOUNTING:

- A. The highest breaker operating handle shall not be higher than 72 inches above the floor.

END OF SECTION

SECTION 26 51 00
LIGHTING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK:

- A. The work of this section consists of providing and installing a complete lighting system, including fixtures, LED light module, hangers, reflectors, glassware, lenses, auxiliary equipment, heat management components, LED driver (integral or remote), and housing.

1.02 RELATED WORK:

- A. See the following specification sections for work related to the work of this section:
 - 1. 16000 General Electrical Requirements.
 - 2. 16110 Conduit, Raceway and Fittings.
 - 3. 16120 Line Voltage Wire and Cable.
 - 4. 16130 Junction and Pull Boxes.

1.03 SUBMITTALS: In accordance with Division 1.

- A. Submit descriptive data, photometric curves for each fixture configuration proposed.
- B. Submit shop drawings showing proposed methods for mounting lighting fixtures.
- C. Seismic Requirements: Submit:
 - 1. Sketch or description of the anchorage system if not provided on construction documents.
- D. Submit Operation and Maintenance Data per Division 1.

1.04 WARRANTY:

- A. LED light module, LED driver, batteries or other luminaire components which fail within the first year after final acceptance shall be replaced by the Contractor with the warranty clause of the General Provisions.
- B. Replacement components provided under warranty to be provided by contractor, not taken from project spare stock.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Fixtures shall be of the types, wattages and voltages shown on the Drawings and be UL or equivalent classified and labeled for the intended use.
- B. Substitutions will not be considered unless the photometric distribution curve indicates the proposed fixture is equal to or exceeds the specified luminaire and the substitution is consistent with the design intent.
- C. Luminaire (factory or field installed) wire, and the current carrying capacity thereof shall be in accordance with the CEC.
- D. Luminaires and lighting equipment shall be delivered to the project site complete, with suspension accessories, aircraft cable, stems, hangers' canopies, hickey, castings, sockets, holders, LED light engine, [lamps], [ballasts], diffusers, frames, and related items, including support and braces.

2.2 LIGHT EMITTING DIODE (LED) LIGHT SOURCES AND LUMINAIRES:

A. General (Non-Emergency):

- 1. Provide identical power supply and driver within each luminaire type. Provide power supplies and drivers that are suitable and UL-listed for the electrical characteristics of the supply circuits to which they are to be connected and which are suitable for operating LED or relevant light sources.
- 2. Unless otherwise specified, provide power supplies of same type and same manufacturer for ease of stocking and replacement.
- 3. Components shall be configured and installed in luminaire by the luminaire manufacturer.
- 4. Luminaire housing shall be constructed of painted metal with no sharp edges unless otherwise noted.
- 5. Provide only luminaires whose design, fabrication and assembly prevent overheating or cycling of light engines or drivers/power supplies under any condition of use.
- 6. Electronic ballasts shall meet the requirements of the Federal Communications Commission Rules and Regulations, Part 18, Part C (RF Lighting Devices) Non-consumer equipment, regarding radio frequency interference (RFI) (radiated) and electromagnetic interference (EMI) (power line conducted).
- 7. Submit light fixture details with luminaire shop drawings.

- B. Emergency Lighting: Battery-backed emergency lighting luminaires shall consist of a normal LED luminaire with some or all of the LEDs connected to a battery and charger.
1. The battery shall be nickel cadmium and sized for a minimum of 90 minutes of luminaire operation unless otherwise noted.
 2. The charger shall be solid-state and include overload, short circuit, brownout and low battery voltage protection.
 3. The battery and charger shall include self-diagnostic and self-exercising circuitry to exercise and test itself for 5 minutes every month and for 30 minutes every 6 months.
 4. The luminaire shall include a test/monitor module with status indicating lights mounted so as to be visible to the public.
 5. The luminaire shall not contain an audible alarm.
 6. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C: LED Performance and component manufacturer requirements.

1. All color characteristics, SPD (Special Power Distribution) CCT, CRI, CIE Chromaticity Coordinates shall be consistent across the entire dimming range.
2. LEDs shall comply with ANSI/NEMA/ANSI C78.377-2008 – Specifications for the Chromaticity of Solid-State Lighting Products. Color shall remain stable throughout the life of the source. The chromaticity of the installed product shall match IES LM-80 data showing that the LED's do not shift more than .005 DuV from submitted documentation.
3. White LEDs shall have a minimum rated source life of 50,000 hours or as specified: Luminaire Schedule. Multicolor LEDs shall have a minimum rated source life of 100,000 hours. LED "rated source life" shall be determined per IES TM-21 - Projecting Long Term Lumen Maintenance of LED Light Sources based on LM-80 test data. Calculated lifetimes exceeding testing hours per TM-21 are not accepted.
4. Luminaire assembly shall include a method of dissipating heat so as to not degrade life of source, electronic equipment, or lenses. LED luminaire housing shall be designed to transfer heat from the LED board to the outside environment. Luminaire housing shall have no negative impact on life of components. Manufacturer shall provide Luminaire Efficacy (lm/W), total luminous flux (lumens), luminous intensity (candelas), chromaticity coordinates, CCT, CRI, optical performance, polar diagrams, and relevant luminance and illuminance photometric data. Provide data in IES file format in accordance with testing standards IES LM-79-08 and IES LM-82-12, based on test results from an independent Nationally Recognized Testing Laboratory or National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory.

5. Manufacturer will keep record of original chromaticity coordinates for each LED module and have replacement modules or luminaires from within three (3) MacAdamEllipses/ steps of the same coordinates available for the duration of the warranty period.
6. Manufacturer's LED light engine or equivalent system will be available for ten (10) years: Manufacturer will provide exact replacement parts, complete replacement luminaires, or provide upgraded parts that are designed to fit into the original luminaire and provide equivalent distribution and lumen output to the original, without any negative consequences.
7. All LED sources used in the LED luminaire shall be of proven quality from established and reputable LED manufacturers and shall have been fabricated within 12 months before installation per the date code on the module. Acceptable LED component or module manufacturers unless otherwise noted are:
 - a. Cree, Inc.
 - b. Lumileds
 - c. Nichia Corporation
 - d. Norlux
 - e. Lextar
 - f. Osram Optronic Semiconductors
 - g. Xicato
 - h. Bridgelux
 - i. Epistar
 - j. San'an
 - k. Citizen Electronics
 - l. General Electric Company
 - m. Sora
 - n. Samsung
 - o. Seoul Semiconductor
 - p. Lumenetix
 - q. Ledengin

2.3 LED POWER SUPPLIES/ DRIVERS:

1. LED driver shall have a minimum 50,000 hour published life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
2. Driver shall be Sound Rated A+.
3. Driver shall be > 80% efficient at full load across all input voltages.
4. Driver shall include ability to turn off at low control input rather than holding at a minimum dimming level, and shall consume 0.5 Watts or less in standby/off mode. Control dead band at low control input shall be included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.
5. Drivers shall track evenly across multiple luminaires at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
6. Control Input:
 - a. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers
 - (i) Must meet IEC 60929 Annex E for General White Lighting LED drivers.
 - (ii) Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V.
 - (iii) Must meet ESTA E1.3 for RGBW LED drivers.
 - b. Digital (DALI Low Voltage Controlled) Dimming Drivers
 - (i) Must meet IEC 62386.
 - c. Digital Multiplex (DMX Low Voltage Controlled) Dimming Drivers
 - (i) Must meet DMX / RDM: USITT DMX512A and ANSI E1.20 (Explore & Address).
 - (ii) Must be capable of signal interpolation and smoothing of color and intensity transitions.
7. Power Factor: The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
8. THD: Total harmonic distortion (current and voltage) induced into an AC power line by luminaire shall not exceed 10 percent at any standard input voltage and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

9. In Rush Current: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps 2 – seconds.
10. RF Interference: The luminaire and associated on-board circuitry must meet Class A emissions limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI emissions.
11. Light engines shall be 3500] 90 CRI minimum, U.O.N. on drawings.
12. Drivers shall be accessible for maintenance or replacement without removal of recessed light fixture and without destruction of the ceiling.

PART 3 – EXECUTION

3.01 INSTALLATION:

A. General:

1. All fixtures and luminaires shall be clean and lamps shall be operable at the time of acceptance.
2. Install luminaires in accordance with manufacturer's instructions, complete with lamps, ready for operation as indicated.
3. Align, mount, and level the luminaires uniformly.
4. Avoid interference with and provide clearance for equipment. Where an indicated position conflicts with equipment locations, change the location of the luminaire by the minimum distance necessary.
5. Recessed light fixtures in fire rated assemblies shall be installed per an approved UL rated fire rated penetration detail.

B. Mounting and Supports:

1. Mounting heights shall be as shown on the Architectural and Electrical Drawings. Unless otherwise shown, mounting height shall be measured to the centerline of the outlet box for wall mounted fixtures and to the bottom of the fixture for suspended fixtures and to the bottom of the fixture for all other types.
2. Luminaire supports shall be anchored to structural members.
3. Pendant stem mounted luminaires shall be provided with ball aligners to assure a plumb installation and shall have a minimum 45-degree clean swing from horizontal in all directions. Sway bracing shall be installed as required to limit the movement of the fixture. Fixtures shall be allowed to sway a maximum of 45° without striking any object.

4. Fixture supports shall be designed to resist earthquake forces of seismic zone 4.
5. Refer to fixture mounting details on drawings for installation requirements.
6. Pendant cable mounted luminaries shall be provided with fully adjustable stainless-steel aircraft cable hangers unless otherwise noted on the Drawings.

END OF SECTION

SECTION 271000
STRUCTURED CABLING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division 26, Basic Materials and Methods sections apply to work specified in this section.

1.2 REFERENCE STANDARDS:

- A. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical Fibers (OM3/OM4). Current Edition
- B. ANSI TIA-492.CAAB – Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak. Current Edition
- C. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises.
- D. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.
- E. ANSI/TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- F. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
- G. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces.
- H. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure.
- I. ANSI/JSTD-607-B – Commercial Building Bonding and Grounding (Earthing) Requirements for Telecommunications.
- J. NFPA 70 – National Electrical Code (NEC).
- K. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.3 DESCRIPTION OF WORK:

- A. The extent of telephone/data system work is indicated and is hereby defined to include, but not be limited to cable, raceway, outlet boxes, device plates, backboard, cabinets, grounding and miscellaneous items required for complete system.
- B. Provide complete cable and outlet system as indicated and described herein. Work includes cable, jacks, terminal blocks, wire management, labeling, transient voltage surge suppression, patch cords, and all terminations. Every cable, conductor and fiber strand installed under this Project shall be properly terminated at both ends and tested.
- C. Refer to other Division sections for requirements for raceways, boxes and fittings, wiring devices, and supporting devices, and other sections, as applicable.
- D. Provide system testing as described herein.

1.4 QUALITY ASSURANCE:

- A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials, which have been UL-listed and labeled. Comply with NEMA standards for low loss extended frequency cable and EIA/TIA TSB-36. Comply with EIA/TIA 568-A, EIA/TIA 569 and manufacturer's recommendations. Comply with EIA/TIA testing standards for horizontal cabling.

1.5 SUBMITTALS AND SUBSTITUTIONS:

- A. Submit manufacturer's data and installation details for all devices, plates, cable, terminal blocks, patch cords, TVSS, wire management, labels and similar equipment.
- B. Submit a copy of certification documents.
- C. Any substitution requests must be submitted in writing, and approved by Owner or Owner's Representative in writing prior to acceptance of bid.
- D. Substitution requests may only be made for products equal to or better than as specified in this document. Proof of "equal or better" status is imposed on the contractor, not the Owner.
- E. Where a specific manufacturer is called out by name, this is the preferred standard. If substitutions are allowed, they are at the discretion of the Owner and based on performance, suitability, quality, administrative requirements, warranty and other factors deemed important to the Owner.
- F. For the purposes of this Specification, "or approved equal" is implied for all specified, named products.

1.6 CONTRACTOR QUALIFICATIONS AND TRAINING:

- A. The contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
1. Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
 2. Provide references of the type of installation detailed in this specification.
 3. Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must have experience using a light meter and OTDR.
 4. Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.
 5. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
 6. Be in business a minimum of five (5) continuous years with a Contractor's license in the state where the project is located, and appropriate for the type of work expected herein.
 7. Member in good standing of the Certified Installer network associated with the products listed in this Specification and authorized for use in this Project. Contractor must be a member of this installer program before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.
 8. Maintain a certified RCDD on staff and utilize certified BICSI Installers for this project.

1.7 WARRANTY:

- A. A Limited Lifetime Product & Performance Warranty covering all components, equipment and workmanship shall be provided to the Owner, submitted in writing with system documentation. The warranty period shall begin on the system's first use by the owner.
1. Horizontal channels shall be completed with end to end solutions, such as the Berk-Tek Leviton Technologies Solutions. Factory-terminated copper and/or fiber optic patch cords from the solutions provider must be used in order to be eligible for the applicable channel performance guarantees.
 2. The Contractor must pre-register the project with the Manufacturer before installation has begun. Following project completion, contractor is responsible for completing all warranty registration procedures on behalf of Owner.

3. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to the owner.
- B. Certified Installer shall provide labor, materials, and documentation in accordance with Manufacturer requirements necessary to ensure that the Owner will be furnished with the maximum available Manufacturer's Warranty in force at the time of this project.
- C. The installed structured cabling system shall provide a warranty guaranteeing a minimum channel performance above the ANSI/TIA 568-C requirements for all category-rated solutions in this Specification. See Products section for performance criteria. Standards-compliant channel or permanent link performance tests shall be performed in the field with a Manufacturer-approved certification tester in the appropriate channel or permanent link test configuration.
- D. Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.
 1. Installer shall submit test results to Manufacturer in the certification tester's original software files.
 2. Installer shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.
 3. Certified Contractor/Integrator must adhere to the terms and conditions of the respective manufacturer's warranty programs.
- E. Installer shall ensure that the Owner receives the manufacturer issued project warranty certificate within 60 calendar days of warranty registration.

1.8 BACKBONE SUBSYSTEMS:

- A. 19" racks, cabinets, patch panels, rack mounting kits for switch and hubs, wire management components, and patch cables shall be furnished and installed by Contractor.
- B. Backbone copper and fiber systems form an interconnected infrastructure between MDF, IDF, and zone enclosures, both inside and between buildings. All cable, connectors, panels and support systems shall be installed and tested by contractor.
- C. Typical Fiber backbone will be Singlemode low-water-peak (OS2) fiber optic cable or Laser-Optimized Multimode (OM3) fiber optic cable as noted below and on plan drawings. Singlemode is typically run between buildings and Multimode fiber is run within the building. Singlemode fiber will be terminated on LC connectors using pre-polished connectors or fusion splice pigtails. Multimode fiber may be terminated on LC connectors using pre-polished connectors or fusion splice pigtails, or may be factory pre-terminated onto MTP multi-fiber connectors.

- D. No splicing of cables will be required or allowed between endpoints. Armored cable must be grounded at both ends if run outdoors. With armored fiber, no innerduct will be required. Check plans for clarification or exceptions.

1.9 WORK AREA SUBSYSTEM:

- A. The connection between the information outlet and the station equipment in the work area is provided by the Work Area Subsystem. It consists of cords, outlets, adapters, and other filters/impedance matching devices.

1.10 HORIZONTAL SUBSYSTEM:

- A. The Horizontal Subsystem is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications room/closet. It consists of the telecommunications outlet/connector, the horizontal cables, optional consolidation point, wireless access point cabling, and that portion of the cross-connect in the telecommunications room/closet serving the horizontal cable. Each floor of a building should be served by its own Horizontal Subsystem.

1.11 ADMINISTRATION SUBSYSTEMS:

- A. The Administration Subsystem links the Horizontal Subsystem and the Backbone Subsystem together. It consists of labeling hardware for providing circuit identification and patch cords or cross connect wire used for creating circuit connection at the cross connects.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide complete raceway, outlet boxes and miscellaneous items as required.
- B. Provide minimum 4-¹¹/₁₆" square outlet box at each outlet location with single gang plaster or tile ring and 1" conduit to cable tray, backboard, or accessible ceiling or floor space.
- C. Provide a complete data cabling and device system as described herein.

2.2 HORIZONTAL CABLING SYSTEMS:

A. NETWORK DATA CABLES

- 1. Provide 4-pair, 100-Ohm balanced unshielded twisted pair (UTP) Cables for each data outlet designated.
- 2. All UTP cables passing through air handling space shall be PLENUM-rated (CMP). Cables not passing through air handling spaces may be PVC (CMR) jacketed. Some buildings will require the use of Plenum cable. The contractor is solely

responsible for verifying the construction requirements and installing the correct cable. Failure to provide CMP cable in Plenum required spaces will result in the contractor removing and replacing the cable at their own expense.

3. CAT6A UTP cable shall conform to the following requirements:

- a. All cables shall be made in the USA of solid annealed copper conductors, 23 AWG, with four individually twisted pairs in a single round cable sheath.
- b. Characterized to 750 MHz, 250 MHz greater than the standard
- c. Outer diameter 0.300" (7.6mm), CMP
- d. Be made by an ISO 9001 and 14001 Certified Manufacturer.
- e. Channel margin guarantees for ANSI/TIA 568-C.2 CAT6A and ISO/IEC 11801 Class E_A (margin vs. ANSI/TIA-568-C.2 and margin guarantees are for a standard 2-connector channel).

Insertion Loss	3%	
NEXT	2 dB	
PSNEXT	3 dB	
ACR-F (ELFEXT)	5 dB	
PSACR-F (PSELFEXT)		6 dB
Return Loss	1 dB	
ACR-N	4 dB	
PSACR-N	5 dB	

Approved Products:

reel) Berk-Tek BLUE LANmark 10G2 Category 6A CMP cable #10130484 (1000'

reel) Berk-Tek BLUE LANmark 10G2 Category 6A CMR cable #10133700 (1000'

* Other colors as appropriate

B. DATA INFORMATION OUTLETS:

1. COPPER PATCH PANELS

- a. Integrated 110-style patch panels shall exceed requirements for Category 6A described in ANSI/TIA-568-C.2 and Class E_A and Class E component requirements (respectively) as described in ISO/IEC 11801 in a typical standard-density (48 ports per 2RU) configuration.
- b. Integrated 110-style patch panels shall be available in flat or angled styles, 24 ports per RU in an un-staggered horizontal layout.
- c. Modular (unloaded) patch panels shall accept the same Universal jacks as are used at the workstation area outlets. No special "panel jacks" shall be required.
- d. Modular patch panels shall be available in flat, angled, Recessed and recessed angled varieties, in 1RU 24 and 48-port versions or 2RU 48 and 72-port configurations.
- e. Patch panels shall be sized to fit an EIA standard, 19-inch relay rack, and made of 16-gauge steel and powder-coated black with white silkscreened lettering.

Approved Product examples:

Leviton CAT6A 110-style Flat 1RU 24-port Patch Panel, # 6A586-U24

Leviton CAT6A 110-style Angled 2RU 48-port Patch Panel, # 6A9587-U48

Leviton QuickPort® 1RU Flat 48-port Patch Panel, # 49255-Q48

2. CAT6A JACKS: Provide modular type Category 6A information outlets for 23-AWG copper cable. These Category 6A (CAT6A) connectors shall be individual snap-in style, and exceed compliance with TIA/EIA-568-C.2 specifications. The connectors shall comply with the following:
 - a. Be 8-position/ 8 conductor (8P8C, RJ45-style) modular jacks.
 - b. Utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products.
 - c. Comply with FCC Part 68; UL listed and CSA Certified. Verified to exceed all channel performance requirements in TIA-568-B.2-10 from 1 MHz to 500MHz to support the IEEE 802.3 standard for 10 Gigabit Ethernet over UTP Cable.
 - d. Each 10G connector is to feature an injection molded Cone of Silence™ technology to eliminate alien crosstalk (AXT).
 - e. Every 10G connector to include polymer springs above the tines ("Retention Force Technology" or similar functionality) to promote return of tines to original position and protect against deformation due to stress of patch cords or inappropriate materials insertion
 - f. Connector shall have Pair Separation Towers on IDC to facilitate quick, easy terminations without a complete untwist of each pair of conductors.
 - g. The connector shall be rear 110-type insulation displacement connectors (IDC) with solder-plated phosphor bronze contacts, configured in a 180° orientation such that the punch down field is in the back, allowing for rear termination.
 - h. The connector shall provide a ledge directly adjacent to the 110-style termination against which the wires can be directly terminated and cut in one action by the installation craftsman.
 - i. Connector wiring label shall provide installation color codes for both T568A and T568B wiring schemes on separate labels.

Approved Products:

Leviton eXtreme CAT6A QuickPort Module # 6110G-R*6

Where * = one of 13 colors. See drawings or check with Owner for application.

3. FACEPLATES: Faceplates provide information outlets to the work area. Contractor shall provide and install single gang faceplate kits to allow up to six data or voice jacks as required for all work area outlets, workstation base feeds, and unused telecom backboxes and furniture openings. Faceplates shall:
 - a. Utilize a Quickport ("keystone"-style) footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
 - b. Match colors and materials of the power wiring device plates.
 - c. Support any connectivity media type, including fiber and copper applications.

- d. Have write-on designation labels for circuit identification together with a clear plastic cover.
- e. Be available in single-gang and double-gang configurations.
- f. Have surface-mount boxes and standoff rings available for both single and double gang faceplates.
- g. Have single-port matching color blank inserts available in packs of 10.
- h. Shall be stainless steel when installed above accessible ceiling.

Approved Products:

Leviton QuickPort Single-Gang, Plain, # 41080-#xP
 Leviton QuickPort Single-Gang with ID Windows, # 42080-#xS
 Leviton QuickPort Blank Inserts, pack of 10, # 41084-BxB
 Leviton QuickPort Stainless Steel wallphone plate, # 4108W-0SP

Where:

= number of ports: 1, 2, 3, 4, 6

x = color: White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)

2.3 BACKBONE CABLING SYSTEMS

A. BACKBONE CABLES:

1. GENERAL

- a. The cable route within a building, connecting closet to closet or closet to the equipment room is the Intrabuilding Backbone Subsystem. It links the Main Distribution Frame (MDF) in the equipment room to Intermediate Distribution Frame (IDF) and Horizontal Cross-connects (HC) in the Telecommunications Room/Closets (TC). It consists of the backbone transmission media between these locations and the associated connecting hardware terminating this media. These fiber optic cables are typically Multimode.
- b. Cables run from building to building in a campus, or from campus to campus are part of the Interbuilding Backbone System. It consists of the backbone transmission media between these locations and the associated connecting hardware terminating these media. These fiber optic cables are typically Singlemode.
- c. Cables allowed for use in the backbone shall support voice, data, video, wireless and building infrastructure applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation. All cables shall conform to ANSI/TIA/EIA-568-C Commercial Building Telecommunications Cabling Standard. These cables include:
 - 1) 4-pair 100-ohm unshielded twisted-pair 100% annealed-copper solid-conductor cables, 100-ohm UTP multi-pair copper cables
 - 2) 50/125 μ m (micron) Laser-Optimized Multi-Mode Fiber (LOMMF) cables (OM3 or better)
 - 3) 8.3 μ m low-water peak singlemode optical fiber cables compliant with

ITU-T G.652D (OS2).

2. VOICE COPPER BACKBONE CABLE

- a. Power-Sum Multi-Pair Category 3 cable, 24 AWG solid-copper conductors in 25-pair binder groups to support 10BASE-T, 100BASE-T and Analog Voice communications at 16Mhz.

Approved Products:

Berk-Tek # 10032111, 25-pr CMP, Gray.

Berk-Tek # 10032396, 25-pr CMR, Gray

Other multiples of 25 acceptable (50, 100, 200, 300 pair as required)

3. SINGLEMODE FIBER OPTIC CABLE

- a. Singlemode fiber optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA/EIA-568-A. Must be a minimum of 12 strands of nominal 8.3-micron optical fiber, and must be appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant, OFNP or OFNR).
- b. Fiber optic cables will utilize an interlocking armor outer cover around an integrated Loose-Tube (indoor/outdoor) cable construction.
- c. Loose tube fibers shall utilize a fan-out kit to fit 250-micron fibers into a 900-micron protective sheath when terminating.
- d. See plans and scope of work for total strand count between locations.

Approved Manufacturers

Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube Plenum cable, 12-strand SM, armored, # LTPK12AB0403

Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube Plenum cable, 24-strand SM, armored, # LTPK12B024AB0403

Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube OFNR cable, 12-strand SM, armored, # LTRK12AB0403

Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube OFNR cable, 24-strand SM, armored, # LTRK12B024AB0403

Leviton 12-fiber, 24" fan-out Kit, # 49887-12S

4. MULTIMODE FIBER OPTIC CABLE – FIELD TERMINATED

- a. Multimode fiber optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA/EIA-568-A. Must be a minimum of 12 strands, typically 24 strands, of Laser-Optimized 50-micron optical fiber. Cable jacketing must be appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant, OFNP or OFNR).
- b. Fiber optic cables will utilize an interlocking armor outer cover around an integrated Tight-Buffered (indoor only) cable construction and fiber strands with a 900-micron protective sheath.
- c. See plans and scope of work for total strand count between locations.

Approved Manufacturers

Berk-Tek Indoor Plenum tight buffered cable, 12-strand OM3 Armored,
PDPK012EB3010/25
Berk-Tek Indoor Plenum tight buffered cable, 24-strand OM3 Armored,
PDPK024EB3010/25
Berk-Tek Adventum Indoor/Outdoor Plenum cable, 12 strands, #
LTP012AB0403
Berk-Tek OSP cable, Loose Tube 12-strand, # OPD012AB0403
Leviton 12-fiber, 24" fan-out Kit, # 49887-12S

5. MULTIMODE FIBER OPTIC CABLES – FACTORY PRETERMINATED

- a. Optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA/EIA-568-A. Cables must be a minimum of 24 strands of 50/125µm (micron) OM3 Laser-Optimized Multi-Mode Fiber (LOMMF) for backbone cabling. Cables must be appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, OFNP or OFNR) but are not suitable for Outside Plant (aerial or underground). Backbone cables may be used rack-to-rack, MDF-to-IDF, or similar intrabuilding applications.
- b. Backbone cables will utilize the MTP® connector, employing a multi-strand ferrule capable of supporting 1G, 10G, 40G or 100G Ethernet and beyond. The MTP® connector is not a field-installable connector, and must be factory polished and tested to ensure precise fiber alignment and finish.
- c. All optical fiber backbone cables (trunks) shall be factory terminated, dry loose tube, armored jacket, Laser Optimized 50-micron OM4+ for plenum-rated applications. All trunks shall be labeled on both ends with machine labeling and bar coded with unique numbers. Labels shall be highly visible with white background and black lettering, and shall list origination and destination on both ends before break of individual legs. All Fiber Trunk assemblies shall possess the following characteristics at a minimum:
 - 1) Meet or exceed TIA 568-C.0 for OM4 performance at 550 meters for 10 Gigabit and 150 meters for 40 Gigabit or 100 Gigabit transmissions.
 - 2) Optical fiber jackets shall be durable jacketed construction utilizing loose tube design, aramid yarn, and fiberglass strength members for protection.
 - 3) Optical fiber cable trunks shall have a minimum breakout of 3 feet. All fiber trunks shall utilize a heat shrink at the ends of all breakouts to create a smooth breakout of the fiber subunit legs.
 - 4) Optical fiber subunits shall utilize a round construction. Ribbon construction is not acceptable.
 - 5) All fiber connectors must meet TIA 604.X for compatibility.
 - 6) All Multimode optical fiber subunits of 24 strands shall utilize the 24-strand MTP connector. Optical Fiber subunits of 12 strands shall utilize a 12-strand MTP connector. No optical fiber subunits shall be smaller than 12 strands except for fiber optic jumpers used within the same racks.
 - 7) Multimode fiber optic trunks shall utilize female MTP connectors. 24-strand MTP connectors shall have a Red boot, and 12-strand MTP shall use a Black boot.

- 8) Singlemode MTP connectors shall be 12-strand, Angle-Polish, and shall have a Green boot.
- 9) Manufacturer shall provide MTP® brand connectors for specific superior performance characteristics. Generic MPO-style connectors are not acceptable quality. Use of only ferrules or other essential components will not be acceptable, but only the complete MTP system of components used at each connector assembly.
- 10) All MTP connectors shall be laser cleaved to increase hardness of tip and precision of end product.
- 11) All Multimode Fiber Optic Trunks shall utilize Method B Polarity. Singlemode fiber optic trunks shall utilize Method C.
- 12) All optical fiber cabling trunks shall have a unique identifying label with a bar code for quick identification. The label shall state Manufacturer, trunk length and serial number. Custom labeling shall be available from the manufacturer as an option to aid in deployment during construction.
- 13) A pulling eye shall be installed on one end of all trunks to help facilitate installation.
- 14) All optical fiber trunks shall be shipped to project site with a number on the box that will correspond to the layout of the facility for easy identification by the Vendor. All fiber trunks shall include a printed summary test file of all fiber strands inside the box for the Vendor. Additionally, the Manufacturer shall hold all full test data until the project is complete and provide them to Owner along with the applications assurance warranty after the project is completed
- 15) Installation contractor will re-test all fiber trunks upon completed installation and provide test results to Manufacturer for completion of full product warranty requirements.
- 16) The contractor shall be responsible for the correct fiber trunk lengths, configuration, and ordering. Fiber Trunk part numbers shall be generated from Leviton.com Online Configurator and must be verified with the Manufacturer prior to ordering.

Approved Products:

Leviton Unity Part # FT-EC024JJ100F36C36CY-NNBS (sample part #, actual part # TDB as required)

Where:

FT	Fiber trunk
E	(G=OM3)
C	Dry loose tube OFNP Plenum, Armored jacket
024	24-strand fiber cable (012 = 12 strand)
JJ	Female 24-strand MTP® on each end (SS= 12-strand MTP/APC)
100F	100' (use 3-digit length and M for meters)
36	36" breakout, end 1
C	3mm jacketed fiber breakout leg
36C	26" breakout, 3mm tubing, end 2
Y	Pulling eye (Yes)
NN	Staggered ends, 1st and 2nd end both (YY, NN, YN, NY options)
B	Polarity Method (B for MM, B for SM)
S	Standard labeling (C for Custom, supply spreadsheet with order)

B. COPPER TERMINATION BLOCKS

1. Provide termination blocks for Category 3 Backbone Cabling Systems that support up to Category 5e applications and facilitate cross-connection using twisted pair wiring.
2. The connecting hardware block shall support the appropriate Category 3 to 5e voice (non-VOIP) applications and facilitate cross-connection and/or inter-connection using cross-connect wire. The cross-connect hardware shall be of 66-type (telephone) AND:
3. The cross-connect shall be Category 5e 110-style wiring bases, mountable to wall or backboard to provide 110 termination capable of supporting voice, security, and Category 5e data applications, including high megabit and shared-sheath applications when used with Category 5e rated cabling.
4. The components shall be UL listed and ANSI/TIA-568-C compliant. Bases shall support 50, 100 or 300 pair densities with provision for ANSI/TIA-606-B compliant labeling. Plastic bases and blocks shall be made of fire-retardant plastic rated UL 94V-0.
5. Cross-connect blocks shall be available in a variety of insulation displacement clips (IDC) with and without tails, and support wire sizes: Solid: Wire Ranges 22-26 AWG (0.64mm - 0.40mm).

Approved Products:

Leviton 110 Connecting Block, 100-pair w/legs # 41AW2-100
Leviton Wire Manager w/legs, # 41A10-HCM

C. FIBER OPTIC ENCLOSURES, PANELS AND TRAYS

1. All Fiber interconnect centers, panels, enclosures and trays (units) shall provide cross-connect, inter-connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.
2. Rack-Mounted, High Density Fiber Interconnect Center: The high density, rack mounted fiber interconnect center shall:
 - a. Fiber enclosure shall be available in 1, 2 and 4RU versions to accommodate termination and splicing of fiber. Enclosure depth shall be 17".
 - b. Enclosure shall feature a sliding tray which removes completely, front or rear, from enclosure to facilitate field terminations and splicing.
 - c. Rack-mount enclosure shall have removable transparent hinged doors and slide away covers allow easy access during install and visibility of interior after install.
 - d. Fiber Adapter Plates (bulkheads) shall accept SC and LC connectors, MTP® adapters, and plug-n-play MTP modules/cassettes.
 - e. Fiber cable management for routing, storage, and protection shall accept patch cords, tight-buffer fiber, and backbone cables. Rear fiber cable

management rings shall be stackable and configurable in ¼, ½, or full ring arrangements. Enclosure shall be constructed of 16-gauge steel with a powder-coated black finish and be mountable in a 19" rack or cabinet frame. An optional locking door feature shall be available.

- f. Enclosure shall be available either empty or in custom pre-loaded configurations, with or without locking doors.

Approved Products:

Leviton Opt-X Ultra Rack-Mount 1RU Enclosure, # 5R1UH-S03
Leviton Opt-X Ultra Rack-Mount 2RU Enclosure, # 5R2UH-S06
Leviton Opt-X Ultra Rack-Mount 4RU Enclosure, # 5R4UH-S12
Leviton lock and key # 5L000-KAL
Leviton armored cable ground kit, # DPGRD-KIT

3. FIBER OPTIC WALL-MOUNT ENCLOSURES

- a. The enclosure shall mount on a wall in an 8"x13", 12"x14" or 17"x15" footprint.
- b. Adapters shall be mounted in metal mounting plates and attached to the enclosure using plastic plungers.
- c. There shall be cable entrance ports in the top and bottom of the patch panel on both the distribution and patch sides.
- d. Cable entrance ports are designed with a strain relief post with a slot capable of holding a tie wrap.
- e. The enclosure shall provide strain relief in the form of a grounding lug and multiple tie wrap points.
- f. The enclosure shall have a plastic fiber management ring made of high impact UL 94V-0 rated fire-retardant plastic. This ring shall be stackable and adjustable. A port identification label/card shall be provided.
- g. The enclosure shall be made of 16-gauge steel powder coated black.

Approved Manufacturers

Leviton Wall Mount Fiber Enclosure, 2-panel, split-metal door w/key, # 5W120-00N, or larger size as appropriate.

D. FIBER TERMINATION PRODUCTS

1. FIBER ADAPTER PLATES

- a. Fiber Adapter Plates shall be used to present field-terminated or pre-terminated discrete, single-strand connectors (e.g. LC) to a fiber enclosure panel.
- b. The fiber adapter plate shall be modular and functional for use in either a wall-mount or rack-mount enclosure. The adapter plate shall be provided in LC styles, in 12- or 24-fiber configurations. 12-fiber adapter plates are used to terminate 12-fiber cables, and 24-fiber adapter plates are used to terminate 24-fiber (or greater) cables. Avoid deployment of adapter plates with unused ports at the rear.

- c. The adapter plate shall be compliant to TIA-568-C.3 (for performance) and respective TIA-604-X (for intermateability) standards. Adapter plates shall use zirconia ceramic sleeves and be offered in standard fiber type colors pursuant to TIA-568-C.3 standards.
- d. LC adapter plates shall be precision-molded in the USA and integrated to eliminate "rattle" and loose fit. All ferrules shall be zirconia-ceramic. Adapter plates shall be offered in standard fiber type colors. Singlemode colors are typically BLUE, Multimode are typically AQUA.

Approved Products:

Leviton Opt-X Fiber Adapter Plate, 12 LC SM Blue, #5F100-2LL
 Leviton Opt-X Fiber Adapter Plate, 24 LC SM Blue, #5F100-4LL
 Leviton Opt-X Fiber Adapter Plate, 12 LC MM Aqua, #5F100-2QL
 Leviton Opt-X Fiber Adapter Plate, 24 LC MM Aqua, #5F100-4QL

2. FIBER CONNECTORS

- a. The fiber optic connector shall meet or exceed the requirements described in ANSI/TIA-568-C.3 and ANSI/TIA-604-3 (LC) Connector Intermateability Standards
- b. Connector shall be pre-polished and field installable to eliminate the need for hand polishing, bonding, or epoxy in the field.
- c. Connector shall be provided in LC, single-mode or multimode (laser optimized) configurations, terminated on 250 or 900 μ m buffered fiber and/or 2mm or 3 mm jacketed fiber.
- d. Maximum connector insertion loss shall be no greater than 0.5 dB, with an average of 0.1 dB (MM) or 0.2dB (SM). Typical connector return loss shall be 35 dB (multimode) and 56 dB (single mode). All versions shall allow continuity to be verified by use of a visual fault locator (VFL).
- e. Connector shall utilize a precision zirconia ceramic ferrule, and be re-terminable up to 3 times during testing without loss of performance.
- f. Connector shall require the use of a cleaver with a guaranteed maximum cleaving angle of 2 degrees for multimode and 1 degree for singlemode fibers.

Approved Products:

Leviton FastCAM LC Singlemode, # 49991-SLC
 Leviton FastCAM LC Multimode, # 49991-LLC
 Leviton / Lynx cleaver # 49886-LNX or equal

3. MTP® MODULES FOR PRE-TERMINATED CABLES

- a. 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 24-strand (12 LC Duplex Port) MTP-LC Cassette module and will utilize a 24-strand MTP connector at each end of the trunk. 12-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 12-strand (6 LC Duplex Port) MTP-LC Cassette module using 12-strand MTP connectors.

- b. 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in MTP 40G connectors will land on an MTP - MTP Cassette module with (3) 8-strand MTP connectors on the front. Trunks utilizing 2 or more 24-strand MTP connectors may land on a MTP module displaying (2) 24-strand MTP connectors in the rear, and (6) 8-strand (40G) MTP connectors in the front. Multiple modules may be required if trunk cables are configured with greater strand counts or connectors.
- c. The MTP modules shall meet the following requirements:
 - 1) Insertable directly into fiber enclosure panel openings with a push-pin/grommet latch.
 - 2) Rated for Laser Optimized Multi-mode OM3 optical fiber.
 - 3) Shall utilize a Red male MTP connection at the rear to designate the 24-strand MTP.
 - 4) Shall utilize Method B Polarity.
 - 5) Shall require one Core module at one end of a fiber trunk segment, and one Edge module at the second end to maintain correct polarity across the system.
 - 6) Core modules will be used at the MDF and Edge modules at the IDF ends of the cable for consistency of design.
 - 7) 40G MTP connector housings at front of module shall be Black.

Approved Products:

Leviton Method B polarity, 24-fiber MTP to LC, OM3, Core module

FM-E024CDC0BC

Leviton Method B polarity, 24-fiber MTP to LC, OM3, Edge module

FM-E024CDC0BE

Leviton Method B polarity, 24-fiber MTP to 3x8-fiber MTP, OM3 module

FM-E024NDC0E

Leviton Method B polarity, 2x24-fiber MTP to 6x8-fiber MTP, OM3 module

FM-F048NDC0B

4. SPLICE TRAYS AND CASSETTES

- a. Fiber splice trays shall mount to rear of enclosure for terminating bulk fiber optic cable to factory terminated fiber optic pigtails.
 - 1) Splice trays shall be offered in mini and high-density versions with removable clear covers for viewing and inspection of fibers.
 - 2) Incoming fiber shall be secured utilizing a ratchet action foam rubber padding clamp feature or tie-down points to minimize crushing of fiber.
 - 3) The trays shall accommodate slack management of both single-mode and multimode 250 or 900µm fiber and protection of (up to) 12 or 24 fiber heat shrink style fusion splices.
 - 4) Heat shrink splice sleeves shall be included. Splice tray shall be made by the fiber enclosure manufacturer.
- b. Fiber pigtail fusion splice modules shall mount to front of fiber enclosure for terminating bulk fiber optic cable to factory terminated fiber optic pigtails, and shall be front-removable.

- 1) Splice Modules shall be offered in 12- or 24-fiber LC for OS2 (Singlemode) and OM3 (Multimode) fiber types. Construction of module shall be of 14-gauge aluminum for robustness and light weight.
- 2) Splice Modules shall be pre-loaded and routed with respective 3-meter, color-coded, 12-strand pigtail assembly.
- 3) Individual pigtails shall have maximum insertion loss of 0.4 dB and 0.35 dB for OM3 and OS2 fiber types, respectively. Return Loss shall be greater than 25 dB (for OM3), 55 dB (for OS2/UPC), and 60 dB (for OS2/APC).
- 4) Individual compartments in splice module shall provide slack storage and bend radius protection for incoming backbone fibers, 900 μ m tight-buffer fibers, and fusion-spliced fibers. Incoming 250 μ m backbone fibers shall be protected by an included braided mesh sleeve. Heat shrink style splice sleeves and tie wraps shall also be included with module.

Approved Products:

Leviton Mini Splice Tray, 12-strand # T5PLS-12F
 Leviton High-Density Mini Splice Tray, 24-strand # T5PLS-24F
 Leviton LC 12-Fiber pigtail kit, OS2, #UPPLC-KIT
 Leviton LC 12-Fiber pigtail kit, OM3, #5LPLC-KIT
 Or
 Leviton Opt-X 12-Fiber LC OS2 Splice Module # SPLCS-12L
 Leviton Opt-X 24-Fiber LC OS2 Splice Module # SPLCS-24L
 Leviton Opt-X 12-Fiber LC OM3 Splice Module # SPLCS-12A
 Leviton Opt-X 24-Fiber LC OM3 Splice Module # SPLCS-24A

E. COPPER AND FIBER OPTIC PATCH CORDS

1. CAT6A PATCH CORDS

- a. Provide factory terminated and tested patch cords from the manufacturer of the structured cabling components. Patch cords must meet or exceed all criteria specified in the horizontal cabling standard subsection above.
- b. Copper patch cords shall exhibit the following characteristics:
 - 1) Slimline, integrated snag-less plug design without incorporating the use of a rubber molded boot.
 - 2) A narrow profile for less congestion in higher density applications and a strain relief boot ensures long-term network performance
 - 3) Copper Category 6A patch cords shall be Component-rated per TIA 568-C.2-10 for CAT 6 and CAT6A component performance and Independently tested and verified by Intertek (ETL).
 - 4) Outside diameter of 0.225" (CAT6) or 0.240" (CAT6A).
 - 5) 26 AWG stranded conductors for maximum flexibility
 - 6) CAT6A cord complies with TIA 568-C.2-10 component requirements for connecting hardware from 1 MHz to 500 MHz, ISO 11801 Class E_A, IEEE 802.3an to support 10GBASE-T networks and cULus listed.
 - 7) Available Lengths: 3', 5', 7', 10', 15', or 20'

- c. Provide factory assembled patch cords meeting or exceeding all criteria specified in the horizontal cabling standard subsection above, in the following quantities:

- 1) (1) 10' CAT 6A patch cable per outlet location/faceplate (drop) for use at the workstation.
- 2) (1) 5' (average) CAT 6A patch cable per outlet location/faceplate (drop) for use at the network switch in the MDF and IDF.
- 3) (1) 3' CAT 6A patch cable per outlet location/faceplate (drop) for use at wireless access points.

Approved Products:

Leviton Slimline CAT6A Component-rated Patch Cord, #6AS10-xx*

Leviton Slimline CAT6 Patch Cord, # 6D460-xx*

Where:

xx = Length in Feet

* = color: White (W), Yellow (Y), Red (R), Blue (L), Green (G), Grey (S), Black (E)

2. FIBER JUMPERS AND ARRAY CORDS

- a. Fiber optic LC-LC patch cords, or jumpers, will make LC connections from the rack termination points to the equipment. The jumpers will meet the following requirements:

- 1) Factory-manufactured using 50/125 μ m Laser Optimized Multi-Mode OM3 optical fiber. Field terminations on fiber jumpers are not acceptable.
- 2) Shall utilize A-B polarity.
- 3) Shall exhibit <0.3 dB insertion loss and -25 dB return loss.
- 4) Shall be thin, round, 2-strand 2mm fiber cable with duplex "Uni-boot" reversing polarity LC connector at both ends to minimize congestion at rack and in cable managers.
- 5) Shall be available in standard lengths of 1, 2, 3, 5 and 10 meters and custom-orderable up to any length of feet or meters

- b. Fiber-Optic MTP-MTP "array cords" shall utilize 8-strand MTP (female) to 8-strand MTP (male) connectors in a 3mm breakout jacket. The array cords will meet the following requirements:

- 1) Array cords shall meet an optical insertion loss not to exceed 0.35 dB per mated connector pair.
- 2) Array cords shall be available in 1-, 2-, 3-, 5-, and 10-meter lengths.
- 3) Array cords shall be compliant with TIA-568-C.3 and IEEE 802.3ba and available in UL Riser or Plenum rated cables (Riser is acceptable for in-rack patching)
- 4) Meets TIA-568-C.3 and IEEE 802.3ba standards (40/100GbE), and adheres to TIA-942 data center design guidelines.
- 5) Boot color for 8-strand MTP array cords shall be Dark Gray.
- 6) MTP shall be pinned on one end, unpinned on the other, and utilize

Method B polarity.

- c. Provide factory assembled patch cords meeting or exceeding all criteria specified in the horizontal cabling standard subsection above, in the following quantities:
 - 1) (2) 2m LC duplex fiber jumper for each backbone cable terminated in IDF and MDF
 - 2) (2) 2m MTP-MTP 8-strand fiber array cord for each backbone cable terminated in MTP ports at IDF or MDF
 - 3) Verify quantities and configuration with owner prior to delivery.

Approved Products:

Leviton LC-LC OM3 Reversing Uniboot duplex jumper, #FPC-M3RR1VVxxxMAB

Leviton LC-LC SM Reversing Uniboot duplex jumper, #FPC-S2RR1VVxxxMAB

Leviton 8-Fiber MTP(f)-MTP(m) Method B OM3 array cord, #5L8MN-BxxM

Where:

xxx or xx = Length in Meters, for example, 010 or 03 as required

F. WIRE MANAGEMENT

- 1. Provide wiring spindles and channels as necessary to allow neat bundling of all wire and cable on backboard. Provide wiring channel (horizontal) above and/or below each termination block or patch panel, or on the side (vertical) as appropriate. Provide wiring channels by same manufacturer of termination blocks or patch panels. Provide nylon or Velcro type ties for all cables at telephone backboard not run in conduit or channels.
- 2. Provide 1RU ring-style horizontal wire managers between every 2 patch panels as space allows. Provide 2RU horizontal wire manager between the Orange and Blue sets of patch panels if in the same rack, and above and below each similarly-apportioned bank of patch panels.
 - a. Cable managers shall be flat, open ring style.
 - b. Do not coil or wind patch cords inside ring-style wire managers.
 - c. Use recessed flat wire manager as needed within enclosed cabinets to route patch cords to opposite sides, where the rings of the flat wire managers would interfere with cabinet door closure.

Approved Products:

Leviton Horizontal manager, 1RU, # 49253-LPM

Leviton Horizontal manager, 2RU, # 49253-BCM

Leviton Recessed Flat Horizontal manager, 1RU, # 49253-RCM

- 3. Provide full height, front-and-rear, 8" wide Vertical Wire Managers at the side of and between each 2-post and/or 4-post termination rack or frame. If space will not allow, the 5" wide wire manager may be substituted at row ends only, leaving the

8" vertical wire manager between each rack. Owner approval in writing is required prior to this substitution.

- a. The vertical cable management system shall be cULus listed, PCI rated for 94V-O, ABS rated for UL94HB, and compliant with ANSI/TIA/EIA 568-B standards.
- b. Mounting hardware shall be included to insure the proper installation to infrastructure. It shall mount onto a standard TIA/EIA recognized equipment rack.
- c. The management system shall offer an assortment of accessories, including a bend radius slack loop organizer, cable retainers, and shall accommodate top, bottom, side and pass-through cable routing. Dual hinged, cable concealing covers shall be included.

Approved Products:

Leviton Vertical 80"L x 8"W x 8"D channel, black cover, #8980L-VFR

4. For enclosed cabinets, provide horizontal wire management as specified above and vertical or integrated vertical wire management as described below, pertinent to the cabinet manufacturer.

G. Power Distribution Units (PDU)

1. Provide (2) vertical PDU per rack or wall cabinet. Unswitched, non-surge suppressed. 30" length for wall cabinets and 48" for floor-mounted cabinets.
2. Utilize plug and receptacle style appropriate for installation circuits and equipment interfaces.

Approved Products

Leviton P1000 series # P1042-10L

Leviton P1000 series # P1044-10L

H. Equipment and Ladder Rack System:

- A. UL listed Chatsworth 19"W x 84"H x 15" D 45 RMU Aluminum 2 post rack P.N. 55053-703
- B. Ladder rack to wall support, Chatsworth Wall Angle Support Kit P.N. 11421-712
- C. Rack to runway support Chatsworth mounting plate P.N. 10595-712
- D. Ladder rack support system, Chatsworth Universal Cable Runway P.N. 10250-712
- E. Straight through ladder rack splice, Chatsworth Butt-Splice Kit P.N. 11301-701
- F. Ladder rack junction splice, Chatsworth Junction Splice Kit P.N. 11302-702
- G. Ladder rack protective end caps, Chatsworth Protective Rubber End Caps P.N.10642-001
- H. Wall support for cable runway Chatsworth Triangular Support Bracket P.N. 11312-712

- I. Provide two single sided equipment shelves on each rack installed, Chatsworth P.N. 40074-700.
- J. Equipment rack bonding material Chatsworth Green Ground Jumper P.N. 40159-009 and Chatsworth Green Cable Runway Ground Strap Kit P.N. 40164-001

I. LABELING:

- A. The contractor shall provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure heat, water, and time.
- B. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- C. Shall be pre-printed using a mechanical means of printing.
- D. Where used for cable marking, provide vinyl substrate with a white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable. The cable marking shall be immediately visible and within two inches from termination point.
- E. Where insert type labels are used, provide clear plastic cover over label.
- F. Copper patch panel labeling shall be completed with adhesive labeling kit specifically designed for the panel, Leviton 49257-QHD.
- G. Labeling P-touch font size 4MM bold, black on White, 3/8" labeling tape on all work stations, panels and devices.
- H. A round Avery label green in color Product Number: 5463 and a station label utilizing the same font size as on work station face plate must be installed on ceiling grid below each wireless cable location for identification. See type "D" Wireless Location Detail.
- I. Labels shall be numbered consecutively and separate for each type of use. Refer to Work Station Details for additional information.
- J. The contractor shall develop and submit for approval a labeling scheme for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall conform to the owner's Labeling Grammar and the TIA/EIA-606A standard.

PART 3 - EXECUTION

3.1 INSTALLATION OF TELEPHONE/DATA SYSTEM:

- A. Install raceway and cable system and specified equipment as indicated to comply with NEC and recognized industry practices.
- B. PRE-INSTALLATION CONFERENCE:
 - 1. Schedule a conference a minimum of five calendar days prior to beginning work of this section.
 - 2. Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.
 - 3. Attendance: Communications system installer, General Contractor, Owners Representatives and any additional parties affected by work of this section.
 - 4. Copy of Manufacturer warranty pre-application, RCDD qualifications, and other material not include in submittals will be provided by Contractor at this time.
- C. WARRANTY:
 - 1. A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin on the systems first use by the Owner.
 - 2. The project must be pre-registered with Manufacturer before installation has begun.
 - 3. Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to Owner.
- D. PATHWAYS AND TOPOLOGY:
 - 1. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.
 - 2. Provide NEC-sized pull boxes for any run greater than 100 feet, or with more than two ninety-degree bends.
 - 3. Maintain a distance of at least 12 inches from all power conduits and cables, and 6 inches from all fluorescent lighting fixtures. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.
 - 4. The backbone subsystem shall include cable installed in a vertical manner between floor telecommunications room/closets (TCs or IDFs) and the main or intermediate cross-connect in a multi-story building and cable installed horizontally between

telecommunications room/closets and the main or intermediate cross-connect in a long single-story building.

5. Unless otherwise recommended by the Owner, all fiber cables will be encased in interlocking armor. All fibers will be terminated in the Telecom Rooms or Cabinets in new fiber enclosures equipped with sufficient ports, slack storage space and splice trays if required to terminate and secure all fibers.
6. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all Telecommunications rooms/closets, such that no drilling of additional sleeves/slots is necessary.
7. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room/closet. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect. This is known as a hierarchical star topology.
8. Backbone pathways shall be installed or selected such that the minimum bend radius of backbone cables is kept within manufacturer specifications both during and after installation.
9. Do not run fiber cables in conduits which are less than 2" in diameter.
10. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.
11. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).
12. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.
13. For voice or data applications, 4-pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room/closet serving that floor to every individual information outlet.
14. The Contractor shall observe the bending radius and pulling strength requirements of the 4-pair UTP and fiber optic cable during handling and installation.
15. Each run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall not contain splices.
16. In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling.
17. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
18. J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports.

19. Install $\frac{3}{4}$ " x 4' x 8' fire-rated plywood across all walls in telecom rooms, from 6" AFF to 8'-6" AFF. Coat with 2 coats of white paint. Do not paint over fire rating stamp.
20. Contractor shall firestop all used pathways which enter or leave the telecom rooms via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Intumescent caulk shall be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables. Appropriate fill ratios must be followed when penetrating fire rated walls.

E. GROUNDING:

1. All grounding / earthing and bonding shall be done to applicable codes, standards and regulations.
2. Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at all MDF and IDF locations, and an in-cabinet grounding busbar at each remote wall-mounted cabinet or telecom enclosure. All ground lugs shall be 2-hole make-up.
3. Electrician will provide connection between TGB and building ground; Telecom contractor (if separate, otherwise electrician) will provide a busbar and ground all equipment and telecom metals to the busbar.
4. Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar.
5. All grounding and bonding conductors shall be copper and may be insulated. When conductors are insulated, the sheath shall be green or marked with a distinctive green color, and shall be listed for the application. The minimum bonding conductor size shall be #6 AWG.
6. The Telecommunications Ground Busbar (TGB) shall be dedicated and pre-drilled copper busbar provided with holes for use with standard sized lugs. This busbar shall have minimum dimensions of .25-inch-thick, 4 inches wide, and be variable in length.
7. Two-hole compression ground lugs shall be Chatsworth 40162-901, 40162-904, 40162-909, and 40162-911, or equal, based on the size of the copper conductor to be terminated.
8. All low voltage systems in this project shall be grounded and bonded.

F. CABLES AND TERMINATIONS:

1. Check plans and symbology for final determination of faceplate constitution or consult with Owner prior to bid.

2. Install additional cables as indicated on the drawings. Do not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound as recommended by cabling manufacturer.
3. Install CAT6A cables for Wireless Access Points and cameras, and CAT6 everywhere else unless otherwise noted.
4. Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.
5. Install all cable in plenum spaces with J-hooks of at least 1" in width to disperse the weight on the bottom cables. Homerun all cable to nearest TR Cabinet.
6. Coordinate with EIA/TIA 569 tables 4.4-1 and 4.4-2 for conduit and splice box sizing.
7. Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install additional cables and modular jacks as indicated on the drawings.
8. Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers' recommendations and procedures as required. All termination hardware shall be rated to exceed Category 6 specifications as specified above.
9. Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.
10. Provide data outlets in surface raceway at 26" on center unless otherwise indicated.

3.2 TERMINAL BLOCKS AND PATCH PANELS:

- A. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.

3.3 PATCH CORDS:

- A. Contractor to provide fiber and copper patch cords in quantities as described as outlined above in section 2.4.G. Neatly install (minimum) one 3', 5' or 7' CAT6 or CAT6A patch cord (as appropriate to reduce unnecessary length in wire managers) at the equipment cabinet between patch panel and owner-provided switches for each classroom and computer location. Dress and bundle patch cords as appropriate for final installation. Provide unused patch cables to Owner upon completion of project.
- B. Patch cables and fiber optic jumpers must be supplied and installed by the vendor for all terminated data drops, between network switches, building hubs, etc. so that building-wide networking will be operational once all installation is complete.
- C. All fiber patch cords and required workstation/equipment patch cords not installed shall be provided in hand to Owners Representative prior to project closeout.

3.4 LABELING:

- A. Provide labels appropriate for all components supplied and installed.
- B. Each faceplate, cable or data outlet (drop) will be numbered with a unique identifier based on coordination with Owner prior to labeling. Contractor must present labeling system for approval, with all shop drawings, prior to start of construction.

3.5 TESTING:

- A. Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.
- B. Tester is to be configured with the specific cable installed, and the Permanent Link test will be performed according to the CAT6A standard methodology. All parameters must exhibit a PASS test result prior to project completion. PASS*, FAIL* or FAIL test results will not be accepted.
- C. Repair and resolve any shortcomings in the test results. Mitigation efforts may require re-termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.
- D. Provide test results to Manufacturer and Owner representative in native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to Owner representative.
- E. Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.

Approved Tester Products:

Fluke DTX or VERSIV platform Cable Certification testers
Linkware Record Management Software

3.6 PROJECT CLOSEOUT:

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. A total of (4) manuals shall be delivered to the Owner. Manuals shall include all service, installation, and programming information.
- B. Provide a full set of "as-built" (redline) drawings in AutoCAD DWG and PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include (1) hard copy paper format of all as-builts in 30"x42" size or equivalent.
- C. Contractor to provide all warranty information to Leviton for processing. Leviton will send warranty document direct to Owner.

3.7 TRAINING:

- A. Provide four (8) hours training on the operation and installation of the data system, at job site, at no cost to owner.

END OF SECTION

SECTION 28 31 00

NETWORKED FIRE ALARM & MASS NOTIFICATION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expandable emergency evacuation fire alarm system.

1.2 RELATED SECTIONS

- A. Section 260500 – General Requirements.

1.3 REFERENCES

- A. Electrical Industries Association (EIA):

1. RS-232-D – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
2. RS-485 – standard defining the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems

- B. National Fire Protection Association (NFPA):

1. NFPA 12 – Standard on Carbon Dioxide Extinguishing Systems.
2. NFPA 13 – Installation of Sprinkler Systems.
3. NFPA 15 – Standard for Water Spray Fixed Systems for Fire Protection.
4. NFPA 16 – Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.
5. NFPA 16A – Standard for the Installation of Closed Head Foam-Water Sprinkler Systems.
6. NFPA 70 – National Electrical Code (NEC).
7. NFPA 72 – National Fire Alarm Code.
8. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
9. NFPA 101 – Life Safety Code.
10. NFPA 750 – Standard on Water Mist Fire Protection Systems.
11. NFPA 5000 – Building Construction and Safety Code.

- C. Underwriters Laboratories (UL):

1. UL 268 – Standard for Smoke Detectors for Fire Alarm Signaling Systems.
2. UL 864 – Standard for Control Units and Accessories for Fire Alarm Systems.
3. UL 1971 – Standard for Signaling Devices for the Hearing Impaired.
4. UL 2572 – Standard for Control and Communication Units for Mass Notification

Systems.

1.4 SYSTEM DESCRIPTION

- A. A new intelligent reporting, Style 7 networked, fully peer-to-peer, microprocessor-controlled fire detection and emergency voice alarm communication system shall be installed in accordance with the specifications and as indicated on the Drawings.
- B. Each Signaling Line Circuit (SLC) and Notification Appliance Circuit (NAC): Limited to only 80 percent of its total capacity during initial installation.
- C. Basic Performance:
 - 1. Network Communications Circuit (NetSOLO) Serving Network Nodes: Wired using single twisted non-shielded 2-conductor cable or connected using approved fiber optic cable between nodes in Class A configuration.
 - 2. Signaling Line Circuits (SLC) Serving Addressable Devices: Wired Class A.
 - 3. Initiation Device Circuits (IDC) Serving Non-addressable Devices Connected to Addressable Monitor Modules: Wired Class A.
 - 4. Notification Appliance Circuits (NAC) Serving Strobes, Horns and Speakers: Wired Class A.
 - 5. On Class A Configurations: Single ground fault or open circuit on Signaling Line Circuit shall not cause system malfunction, loss of operating power, or ability to report alarm.
 - 6. Alarm Signals Arriving at INCC COMMAND CENTER: Not be lost following primary power failure until alarm signal is processed and recorded.
 - 7. Transponders:
 - a. Operate in peer-to-peer fashion with other panels and transponders in system.
 - b. Each transponder shall store copy of audio evacuation messages and tones.
 - c. Systems that use centralized message storage and control at main fire alarm control panel shall not be acceptable.
 - 8. Network Node Communications, Audio Evacuation Channels and Fire Phone Communications:
 - a. Communicated between panels and transponders on single twisted pair of copper wires or fiber optic cables.
 - b. To enhance system survivability, ability to operate on loss of INCC Command Center, short or open of entire riser at INCC Command Center shall be demonstrated at time of system acceptance testing.
 - c. Systems that are not capable of providing true Class A performance for fire fighter's phone communications shall not be acceptable.
 - 9. Signaling Line Circuits (SLC):
 - a. Reside in remote transponders with associated audio zones.
 - b. SLC modules shall operate in peer-to-peer fashion with all other panels and transponders in system.
 - c. On loss of INCC Command Center, each transponder shall continue to communicate with remainder of system, including all SLC functions and audio messages located in all transponders.
 - d. Systems that provide a "Degraded" mode of operation upon loss of INCC Command Center or short in riser shall not be acceptable.
 - 10. Audio Amplifiers and Tone-Generating Equipment: Electrically supervised for normal and abnormal conditions.
 - 11. Amplifiers: Located in transponder cabinets serving no more than 3 floors per transponder to enhance system survivability, reduce required riser wiring, simplify installation, and reduce power losses in length of speaker circuits.

12. Speaker NAC Circuits: Arranged such that there is a minimum of 1 speaker circuit per fire alarm zone.
 13. Notification Appliance Circuits (NAC), Speaker Circuits, and Control Equipment: Arranged such that loss of any 1 speaker circuit will not cause loss of any other speaker circuit in system.
 14. Speaker Circuits:
 - a. Electrically supervised for open and short circuit conditions.
 - b. If short circuit exists on speaker circuit, it shall not be possible to activate that circuit.
 - c. Arranged for 25 or 70 VRMS and shall be power limited in accordance with NEC
 - d. 20 percent spare capacity for future expansion or increased power output requirements.
 15. Speaker Circuits and Control Equipment:
 - a. Arranged such that loss of any 1 speaker circuit will not cause loss of any other speaker circuit in system.
 - b. Systems utilizing "bulk" audio configurations shall not be acceptable.
 16. 2-Way Telephone Communication Circuits:
 - a. Shall communicate digitally over the network between transponders.
 - b. Supervised for open and short circuit conditions.
 - c. Short circuit condition on 2-way telephone communications circuit shall result in trouble condition and not result in call-in condition.
 17. Voice Communication:
 - a. Connect telephone circuits to speaker circuits to allow voice communication over speaker circuit from telephone handset.
 - b. Capable of remote phone-to-phone conversations and party-line communications as required.
- D. Basic System Functional Operation: When fire alarm condition is detected and reported by 1 of the system alarm initiating devices, the following functions shall immediately occur:
1. System Alarm LEDs: Flash.
 2. Local Piezo-Electric Signal in Control Panel: Sound at a pulse rate.
 3. 80-Character LCD Display: Indicate all information associated with fire alarm condition, including type of alarm point and its location within protected premises.
 4. Historical Log: Record information associated with fire alarm control panel condition, along with time and date of occurrence. History Log shall have capacity for recording up to 4,100 events.
 5. System output programs assigned via control-by-event equations to be activated by particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
 - a. Close Fire Doors
 - b. Shot down air handlers as required by code
 - c. Notify the Central Station or Municipal Tie.
 6. Strobes flash synchronized continuously.
 7. Audio Portion of System: Sound alert tone followed by pre-recorded message determined by event and this scenario repeating or other message as approved by local authority until system is reset.
- E. Fire Alarm System Functionality:

1. Provide complete, electrically supervised distributed, Class A networked analog/addressable fire alarm and control system, with analog initiating devices, integral multiple-channel voice evacuation, and fire fighter's phone system.
2. Fire Alarm System:
 - a. Consist of multiple-voice channels with no additional hardware required for total of 4 channels.
 - b. Incorporate multiprocessor-based control panels, including model E3 Series modules includes Intelligent Network INCC Command Center(s) (INCC), Intelligent Loop Interface (ILI-MB-E3 or ILI-MB-E3), Intelligent Network Transponders (INX), communicating over peer-to-peer token ring network with standard capacity of up to 64 nodes expandable to 122.
3. Each ILI-MB-E3 or ILI-MB-E3 Node: Incorporate 2 Signaling Line Circuits (SLC), with capacity to support in Velociti ® mode up to 159 analog addressable detectors and 159 addressable modules per ILI-MB-E3 SLC or support in Apollo mode up to 126 detectors and modules per ILI-MB-E3 SLC.
4. Voice, Data, and Fire Fighter's Phone Riser: Transmit over single pair of wires or fiber optic cable.
5. Each Intelligent Network Transponder: Capable of providing 16 distributed voice messages, fire fighter phones connections, SLC loop for audio control devices, and integral network interface.
6. Each Network Node: Incorporate Boolean control-by-event programming, including as a minimum AND, OR, NOT, and Timer functions.
7. Control Panels: Capability to accept firmware upgrades via connection with laptop computer, without requirement of replacing microchips.
8. Network:
 - a. Based on peer-to-peer token ring technology operating at 625 K baud, using Class A configuration.
 - b. Capability of using twisted-pair wiring, pair of fiber optic Multi-mode cable strands up to 200 microns or Single-mode optimized for 9/125 microns, or any combination, to maximize flexibility in system configuration.
9. Each Network Node:
 - a. Capability of being programmed off-line using Windows-based software supplied by fire alarm system manufacturer. Capability of being downloaded by connecting laptop computer into any other node in system. Systems that require system software to be downloaded to each transponder at each transponder location shall not be acceptable.
 - b. Capability of being grouped with any number of additional nodes to produce a "Region", allowing that group of nodes to act as 1, while retaining peer-to-peer functionality. Systems utilizing "Master/Slave" configurations shall not be acceptable.
 - c. Capability of annunciating all events within its "Region" or annunciating all events from entire network, on front panel LCD or touchscreen display without additional equipment.
10. Each SLC Network Node: Capability of having integral DACT (digital alarm communicator transmitter) that can report events in either its region, or entire network to single central station monitoring account.
11. Each Control Panel: Capability of storing its entire program, and allow installer to activate only devices that are installed during construction, without further downloading of system.

12. Password Protection: Each system shall be provided with 4 levels of password protection with up to 16 passwords.
13. Have the capacity for multiple pre-recorded messages (at least sixteen (16), but more if required by local AHJ) and address a list of subjects.
 - Fire evacuation and relocation
 - Intruder or hostile person sighted within or around the building grounds
 - Directions to occupants to take cover within building
 - Emergency weather conditions appropriate for local area
 - All Clear

1.5 SUBMITTALS

- A. In accordance with Division 26.
- B. Include sufficient information, clearly presented, to determine compliance with the specifications and the Drawings.
- C. Equipment Submittals:
 1. Cover Page: Indicate the following:
 - a. Project name and address.
 - b. Engineered systems distributor's name and other contact information.
 - c. Installing contractor's name and other contact information.
 - d. Date of equipment submittals. Indicate on revised submittals the original submittal date and revised submittal date.
 2. Table of Contents: Lists each section of equipment submittal.
 3. Scope of Work Narrative: Detail indented scope of work.
 4. Sequence of Operations: Use matrix or written text format, detailing activation of each type of device and associated resulting activation of the following:
 - a. Control panel.
 - b. Annunciator panels.
 - c. Notification appliances.
 - d. Building fire safety functions, including elevator recall, elevator power shutdown, door lock release, door holder release, HVAC unit shutdown, smoke evacuation system activation, and stair pressurization fan activation.
 5. Bill of Material: Indicate for each component of system the following:
 - a. Quantity.
 - b. Model number.
 - c. Description.
 6. SLC Circuit Schedule: Detail address and associated description of each addressable device. Clearly provide information that indicates number of both active and spare addresses.
 7. Battery Calculations: Show load of each of, and total of, components of system along with standby and alarm times that calculations are based on. Show calculated spare capacity and size of intended battery.
- D. Shop Drawings:
 1. Cover Page: Indicate the following:

- a. Project name and address.
 - b. Engineered systems distributor's name and other contact information.
 - c. Installing contractor's name and other contact information.
 - d. Date of equipment submittals. Indicate on revised submittals the original submittal date and revised submittal date.
2. Floor Plans:
 - a. Provide separate floor plan for each floor.
 - b. If a floor plan must be split using match lines to fit on the page, provide match lines and match line references that refer to sheet number that shows area on opposite side of match line.
 - c. Prepare using AutoCAD.
 - d. Prepare to scale 1/8 inch = 1'-0", unless otherwise required by the Architect or Engineer.
 - e. Show equipment and device locations.
 - f. Show wiring information in point-to-point format.
 - g. Show conduit routing, if required by the AHJ.
3. Title Block: Provide on each sheet and include, at a minimum, the following:
 - a. Project name.
 - b. Project address.
 - c. Sheet name.
 - d. Sheet number.
 - e. Scale of drawing.
 - f. Date of drawing.
 - g. Revision dates, if applicable.
4. Control Panel: Provide sheet that details exterior and interior views of control panel and clearly shows associated wiring information.
5. Annunciator Panels: Provide sheet that details exterior and interior views of annunciator panels and clearly shows associated wiring information.

E. Certification: Submit with equipment submittals and shop drawings, letter of certification from major equipment manufacturer, indicating proposed engineered system distributor is an authorized representative of major equipment manufacturer. System distributor and installer shall be a company such as Sound and Signal, Inc. (925) 455-1778, www.soundandsignal.com

F. Project Record Drawings:

1. Submit complete project record drawings within 14 calendar days after acceptance test.
2. Project record drawings shall be similar to shop drawings, but revised to reflect changes made during construction.

G. Operation and Maintenance Manuals:

1. Submit complete operation and maintenance manuals within 14 calendar days after acceptance test.
2. Operation and maintenance manuals shall be similar to equipment submittals, but revised to reflect changes made during construction.
3. Include factory's standard installation and operating instructions.

1.6 QUALITY ASSURANCE

A. Codes and Standards:

1. NFPA: System shall comply with the following NFPA codes and standards:

- a. NFPA 12.
- b. NFPA 13.
- c. NFPA 15.
- d. NFPA 16.
- e. NFPA 16A.
- f. NFPA 70.
- g. NFPA 72.
- h. NFPA 90A.
- i. NFPA 101.
- j. NFPA 750.
- k. NFPA 5000.

2. ADA: System shall conform to American with Disabilities Act (ADA).

B. To ensure reliability and complete compatibility, all items of fire alarm system, including control panels, power supplies, initiating devices, and notification appliances, shall be listed by Underwriters Laboratories Inc. (UL) and shall bear "UL" label.

C. Fire Alarm Control Panel Equipment: UL-listed under UL 864 Ninth Edition and UL 2572.

D. Equipment, Programming, and Installation Supervision:

- 1. Provide services of approved Platinum Level engineered systems distributor of Gamewell-FCI for equipment, programming, and installation supervision.
- 2. Provide proof of factory training within 14 calendar days of award of the Contract.

E. Software Modifications:

- 1. Provide services of Platinum Level Gamewell-FCI factory-trained and authorized technician to perform system software modifications, upgrades, or changes.
- 2. Provide use of all hardware, software, programming tools, and documentation necessary to modify fire alarm system software on-site.
- 3. Modification includes addition and deletion of devices, circuits, zones, and changes to system operation and custom label changes for devices or zones.
- 4. System structure and software shall place no limit on type or extent of software modifications on-site.
- 5. Modification of software shall not require power-down of system or loss of system fire protection while modifications are being made.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

- C. Handling: Protect materials from damage during handling and installation.

1.9 WARRANTY

- A. Warranty Period for System Equipment: 1 year from date of final acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Gamewell-FCI, Honeywell Fire Systems, 12 Clintonville Road, Northford, Connecticut 06472. Phone (203) 484-7161. Fax (203) 484-7118. Website: www.gamewell-fci.com.
- B. References to manufacturer's model numbers and other information is intended to establish minimum standards of performance, function, and quality. Equivalent equipment from Gamewell may be substituted for the specified equipment, as long as minimum standards are met. No other manufacturers, other than Gamewell-FCI, FCI, and Gamewell will be considered for use on this project.
- C. Substitute equipment proposed as equal to equipment specified shall meet or exceed requirements of this section. For equipment other than Gamewell-FCI E3 Series Expandable Emergency Evacuation Fire Alarm System, provide proof that such substitute equipment equals or exceeds features, functions, performance, and quality of specified equipment. This proof shall be provided by submission of a copy of specification with each copy of the submittals that has had each paragraph marked as either compliant or non-compliant along with a letter from engineering manager or product manager at factory that certifies information presented as either compliant or non-compliant including a detailed explanation of each paragraph identified as non-compliant. In order to ensure that the Owner is provided with a system that incorporates required survivability features, this letter shall also specifically certify that the system is capable of complying with the test requirements of this section.

2.2 DISTRIBUTED NETWORKED FIRE ALARM SYSTEM

- A. Distributed Networked Fire Alarm System: Gamewell-FCI E3 Series Expandable Emergency Evacuation Fire Alarm System.

2.3 INTELLIGENT NETWORK INCC COMMAND CENTER HARDWARE

- A. Intelligent Network INCC Command Center (INCC): Supply user interface, including LCD or touch-screen 1/4 VGA display Intelligent Loop Interface Modules (ILI-MB-E3/ILI-MB-E3), manual switching, phone, and microphone inputs to the network. INCC shall consist of the following units and components:
 - 1. System Cabinet (B-, C-, or D-Size Cabinet) with associated inner door.
 - 2. Power Supply Module (PM-9) with batteries.
 - 3. Intelligent Network Interface Voice Gateway (INI-VG).

4. 80-Character LCD Display (LCD-E3).
5. Intelligent Loop Main Board Interface (ILI-MB-E3 or ILI-MB-E3).
6. Optional Intelligent Loop Supplemental Interface (ILI-S-E3 or ILI-S-E3).
7. Optional DACT (DACT-E3).
8. Optional ARCNET Repeater (RPT-E3) with fiber optic modules (FSL-E3 or FML-E3).
9. Optional 1/4 VGA touch-screen display (NGA).
10. Optional Auxiliary Switch Module (ASM-16).
11. Optional LED Driver Module (ANU-48)
12. Optional Microphone Assembly (INCC-MIC).
13. Optional Telephone Assembly (INCC-TEL).
14. Optional AM-50 Series amplifiers (AM-50, AM-50-70).
15. Optional Addressable Node Expander (ANX-SR, ANX-MR-FO, ANX-MR-UTP).

B. System Cabinet:

1. Surface or semi-flush mounted with texture finish.
2. Consist of back box, inner door, and door.
3. Available in at least 3 sizes to best fit project configuration.
4. Houses 1 or more PM-9 Power Supply Modules, INI-VG Intelligent Network Interface Voice Gateway, 1 or more ILI-MB-E3/ILI-MB-E3 assemblies, and other optional modules as specified.
5. Construction: Dead-front steel construction with inner door to conceal internal circuitry and wiring.
6. Wiring Gutter Space: A minimum of 1-inch wiring gutter space behind mounting plate.
7. Wiring: Terminated on removable terminal blocks to allow field servicing of modules without disrupting system wiring.

C. Power Supply Module (PM-9): Use latest technologies to provide system power, incorporates the following features:

1. Power-saving switching technology using no step-down transformers.
2. 9-amp continuous-rated output to supply up to all power necessary under normal and emergency conditions for INCC Command Center Modules.
3. Integral battery charger with capacity to charge up to 55 amp-hour batteries while under full load.

D. Batteries:

1. Sufficient capacity to provide power for entire system upon loss of normal AC power for a period of 24 hours with 15 minutes of alarm signaling at end of this 24-hour period, as required by NFPA 72, Local Systems.
- 2.

E. Intelligent Network Interface Voice Gateway INCC Command Center (INI-VG): INI-VG shall be a multi-function board interchangeable in both INCC and INX. Functions of board shall have the following features as a minimum:

1. Microprocessor shall monitor all system events and perform all system programs, for all control-by-event (CBE) functions. System program shall not be lost upon failure of both

- primary and secondary power. Programming shall supporting Boolean logic including AND, OR, NOT, TIMING functions for maximum flexibility.
2. Network Interface: Operate at 625 K baud configurable with any combination of wire and/or fiber topologies. Interface shall communicate with up to 122 nodes in peer-to-peer fashion.
 3. Fire Fighter Phone Riser: INI-VG shall generate local phone riser for use with AOM-TEL phone modules for connection to fire fighter phone stations and/or for connection of local phone when used as INCC Command Center, including phone circuits. INI-VG shall mix its local phone riser to network in true Class A fashion. Systems not capable of true Class A communications for fire fighter's phone risers shall not be acceptable.
 4. Advanced Processing: INI-VG shall incorporate latest in digital signaling processing technology with supporting Boolean logic including AND, OR, NOT, TIMING, COUNT, SCHEDULE functions.
 5. Microphone Input: On-board and allow for addition of local microphone when used as INCC Command Center, including speaker circuit control.
 6. Signal Processing: INCC shall use advanced Digital Signal Processing (DSP) technology to allow maximum flexibility of digital audio and control capabilities and operation. Signals to and from INCC shall be transmitted over single pair of twisted unshielded wire or fiber optic pair.
 7. Field Programmable: INCC shall be capable of being fully programmed or modified by Field Configuration Program (FCP), to be downloaded via portable computer from any node in system.
 8. Control-by-Event Programming (CBE): INCC shall be capable of programming using Boolean logic including AND, OR, NOT, COUNT, TIMING, and SCHEDULE functions to provide complete programming flexibility.
 9. Remote INCC Command Center Options: System shall have capability of adding remote INCC Command Centers or re-locating INCC Command Centers utilizing only single pair of twisted unshielded wire or fiber optic pair for all functions.
 10. RS-485 Serial Output: System shall incorporate RS-485 bus via ribbon harness for connection of modules inside same cabinet, and via 4-wire quick connector for connection of modules up to 3,000 feet from cabinet.
 11. Riser Wiring: All data, voice, and fire fighter phone riser shall transmit over single pair of twisted unshielded wire or fiber optic pair for all functions configured in Class A format. Any short or open in data, voice, or phone sections shall not affect transmission over remainder of network.
 12. Class A Network: All communication between control panels and transponders shall be through supervised Style 7 token passing network. In event of single short, open, or ground, all system communication shall operate as normal and report fault. This protection shall incorporate all data, voice, and fire fighter phone transmissions. Upon single short, open, or ground of either system data, live voice, pre-recorded channels, or phone risers, the function of each of these items shall continue to operate. "Degrade" functionality shall not be acceptable. This shall be demonstrated at system acceptance.

F. LCD Display Module (LCD-E3):

1. LCD Display: 80-character RS-485 based textual annunciator with capability of being mounted locally or remotely. Provides audible and visual annunciation of all alarms and trouble signals. Provide dedicated LEDs for:
 - a. AC Power On: Green.

- b. Alarm: Red.
 - c. Supervisory: Yellow.
 - d. System Trouble: Yellow.
 - e. Power Fault: Yellow.
 - f. Ground Fault: Yellow.
 - g. System Silenced: Yellow.
 - 2. 80-Character Alphanumeric Display: Provide status of all analog/addressable sensors, monitor and control modules. Display shall be liquid crystal type (LCD), clearly visible in dark and under all light conditions.
 - 3. Panel shall contain 4 functional keys:
 - a. Alarm Acknowledge.
 - b. Trouble Acknowledge.
 - c. Signal Silence.
 - d. System Reset/Lamp Test.
 - 4. Panel shall contain 3 configuration buttons:
 - a. Menu/Back.
 - b. Back Space/Edit.
 - c. OK/Enter.
 - 5. Panel shall have 12-key telephone-style keypad to permit selection of functions.
- G. Intelligent Loop Interface (ILI-MB-E3/ILI-MB-E3): System shall be of multiprocessor design to allow maximum flexibility of capabilities and operation. Intelligent Loop Interface shall be capable of mounting in stand-alone enclosure or integrated with Intelligent Network INCC Command Center (INCC) as specified.
- 1. Field Programmable: System shall be capable of being programmed by Field Configuration Program (FCP), allowing programming to be downloaded via portable computer from any node on network.
 - 2. RS-232C Serial Output: Supervised RS-232C serial port shall be provided to operate remote printers and/or video terminals, accept downloaded program from portable computer, or provide 80-column readout of all alarms, troubles, location descriptions, time, and date. Communication shall be standard ASCII code operating from 1,200 to 115,200 baud rate.
 - 3. RS-485 Serial Output: Each ILI-MB-E3/ILI-MB-E3 shall incorporate RS-485 bus via ribbon harness for connection of modules inside same cabinet, and via 4-wire quick connector for connection of modules up to 3,000 feet from cabinet. RS-485 bus shall support up to 16 ASM-16 auxiliary switch modules, 6 LCD-E3 main annunciators, and 5 LCD-7100 annunciators.
 - 4. Peer-to-Peer Panel Configuration: All Loop Interface Modules shall incorporate own programming, log functions, Central Processor Unit, and control-by-event (CBE) programming. If any loop becomes disabled, each remaining loop driver shall continue to communicate with remainder of network and maintain normal operation. "Degrade" configurations under these conditions shall not be acceptable.
 - 5. Control-by-Event (CBE) Program: ILI-MB-E3/ILI-MB-E3 shall be capable of programming using Boolean logic including AND, OR, NOT, TIMING, COUNT, SCHEDULE functions to provide complete programming flexibility.
 - 6. Alarm Verification: Smoke detector alarm verification shall be standard option while allowing other devices such as manual stations and sprinkler flow to create immediate

- alarm. This feature shall be selectable for smoke sensors that are installed in environments prone to nuisance or unwanted alarms.
7. Alarm Signals: All alarm signals shall be automatically latched or “locked in” at control panel until operated device is returned to normal and control panel is manually reset. When used for sprinkler flow, “SIGNAL SILENCE” switch may be bypassed, if required by AHJ.
 8. Electrically Supervised:
 - a. Each SLC and NAC circuit shall be electrically supervised for opens, shorts, and ground faults. Occurrence of fault shall activate system trouble circuitry, but shall not interfere with proper operation of other circuits.
 - b. Yellow “SYSTEM TROUBLE” LEDs shall light and system audible sounder shall steadily sound when trouble is detected in system. Failure of power, open or short circuits on SLC or NAC circuits, disarrangement in system wiring, failure of microprocessor or any identification module, or system ground faults shall activate this trouble circuit. Trouble signal shall be acknowledged by operating “TROUBLE ACKNOWLEDGE” switch. This shall silence sounder. If subsequent trouble conditions occur, trouble circuitry shall resound. During alarm, all trouble signals shall be suppressed with exception of lighting yellow “SYSTEM TROUBLE” LEDs.
 9. Drift Compensation – Analog Smoke Sensors: System software shall automatically adjust each analog smoke sensor approximately once each week for changes in sensitivity due to effects of component aging or environment, including dust. Each sensor shall maintain its actual sensitivity under adverse conditions to respond to alarm conditions while ignoring factors which generally contribute to nuisance alarms. System trouble circuitry shall activate, display “DIRTY DETECTOR” and “VERY DIRTY DETECTOR” indications and identify individual unit that requires maintenance.
 10. Analog Smoke Sensor Test: System software shall automatically test each analog smoke sensor a minimum of 3 times daily. Test shall be recognized functional test of each photocell (analog photoelectric sensors) and ionization chamber (analog ionization sensors) as required annually by NFPA 72. Failure of sensor shall activate system trouble circuitry, display “Test Failed” indication, and identify individual device that failed.
 11. Off-Premises Connection:
 - a. Fire Alarm System: Connect via Digital Alarm Communicator Transmitter (DACT) and telephone lines to central station or remote station. Panel shall contain disconnect switch to allow testing of system without notifying fire department.
 14. Central Station Option: Fire alarm control panel shall provide integral Digital Alarm Communicator Transmitter (DACT) for signaling to central station. DACT shall contain “Dialer-Runaway” feature preventing unnecessary transmissions as result of intermittent faults in system and shall be Carrier Access Code (CAC) compliant, accepting up to 20-digit central station telephone numbers. Fire department shall be consulted as to authorized central station companies serving municipality. Fire alarm system shall transmit both alarm and trouble signals, with alarm having priority over trouble signal. Contractor shall be responsible for all installation charges and Owner will be responsible for line lease charges.

15. Network Annunciator Option: Each ILI-MB-E3 or ILI-MB-E3 and associated display shall provide option of being configured as network annunciator. Options for annunciation shall default as regional annunciator with capability of selecting global annunciation to provide system-wide protection and Acknowledge, Silence, and Reset capabilities.
16. Redundant History Log: Each ILI-MB-E3 or ILI-MB-E3 shall contain full 4100 event history log supporting local and network functions. If a main processor or network node is lost the entire log shall be accessible at any other Loop Interface board. This shall be demonstrated by removing power from INCC Command Center followed by extraction of history log from any loop driver location, including INCC Command Center or Transponder.
17. LEDs Indicator and Outputs: Each ILI-MB-E3/ILI-MB-E3 Loop Interface shall incorporate as a minimum the following diagnostic LED indicators:
 - a. Power: Green.
 - b. Alarm: Red.
 - c. Supervisory: Yellow.
 - d. General Trouble: Yellow.
 - e. Ground Fault: Yellow.
 - f. Transmit: Green.
 - g. Receive: Green.
18. Auxiliary Power Outputs: Each ILI-MB-E3/ILI-MB-E3 Loop Interface shall provide the following supply outputs:
 - a. 24 VDC non-resettable, 1 amp. maximum, power limited.
 - b. 24 VDC resettable, 1 amp. maximum, power limited.
19. Microprocessor: Loop interface shall incorporate 32-bit RISC processor. Isolated "watchdog" circuit shall monitor microprocessor and upon failure shall activate system trouble circuits on display. Microprocessor shall access system program for all control-by-event (CBE) functions. System program shall not be lost upon failure of both primary and secondary power. Programming shall support Boolean logic including AND, OR, NOT, TIME DELAY functions for maximum flexibility.
20. Auto Programming: System shall provide for all SLC devices on any SLC loop to be pre-programmed into system. Upon activation of auto programming, only devices that are present shall activate. This allows for system to be commissioned in phases without need of additional downloads.
21. Environmental Drift Compensation: System shall provide for setting Environmental Drift Compensation by device. When detector accumulates dust in chamber and reaches unacceptable level but yet still below allowed limit, control panel shall indicate maintenance alert warning. When detector accumulates dust in chamber above allowed limit, control panel shall indicate maintenance urgent warning.
22. NON-FIRE Alarm Module Reporting: Non-reporting type ID shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall

not affect control panel operation nor shall it display message at panel LDC. Activation of NON-FIRE point shall activate control by event logic, but shall not cause indication on control panel.

23. 1-Man Walk Test:

- a. System shall provide both basic and advanced walk test for testing entire fire alarm system. Basic walk test shall allow single operator to run audible tests on panel. All logic equation automation shall be suspended during test and while annunciators can be enabled for test, all shall default to disabled state. During advanced walk test, field-supplied output point programming shall react to input stimuli, such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch input. Advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device, and wiring operation/verification.
- b. Test feature is intended to provide for certain random spot testing of system and is not intended to comply with requirements of testing fire alarm systems in accordance with NFPA 72, as it is impossible to test all functions and verify items such as annunciation with only 1 person.

24. Signaling Line Circuits: Each ILI-MB-E3 module shall provide communication with analog/addressable (initiation/control) devices via 2 signaling line circuits. Each signaling line circuit shall be capable of being wired Class B, Style 4 or Class A, Style 6. Circuits shall be capable of operating in NFPA Style 7 configuration when equipped with isolator modules between each module type device and isolator sensor bases. Each circuit shall communicate with a maximum of 159 analog sensors and 159 addressable monitor/control devices. Unique 40-character identifier shall be available for each device. Devices shall be of the Velocity series with capability to poll 10 devices at a time with a maximum polling time of 2 seconds when both SLCs are fully loaded.

25. Notification Appliance Circuits: 2 independent NAC circuits shall be provided on ILI-MB, polarized and rated at 2 amperes DC per circuit, individually over current protected and supervised for opens, grounds, and short circuits. They shall be capable of being wired Class B, Style Y or Class A, Style Z.

26. Alarm Dry Contacts: Provide alarm dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system alarm occurs.

27. Supervisory Dry Contacts: Provide supervisory dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system supervisory condition occurs.

28. Trouble Dry Contacts: Provide trouble dry contacts (Form C) rated 2 amps at 30 VDC (resistive) and transfer whenever system trouble occurs.

H. Auxiliary Switch Module (ASM-16):

1. Each ASM-16 has 16 programmable push-button switches.
2. Each push-button switch has 3 associated status LEDs (red, yellow, and green), configurable to indicate any combination of functions.

3. Flexible switch configurations to allow flexible set-up of phone, speaker, and auxiliary function circuits.
 4. An insertable label to identify function of each switch and LEDs combination.
 5. Provide capability to communicate with up to 16 ASM-16 modules locally, up to 3,000 feet from INCC Command Center.
 6. Specialty modules that only perform 1 task such as speaker, phone, or auxiliary shall not be acceptable.
- I. Telephone Assembly: Include the following items:
1. Mounting cabinet which occupies 2 module locations on inner door of INCC.
 2. Standard phone operating on piezo effect with integral 6-foot cord.
 3. Interconnect cable for connection of phone to Command Center.
- J. Microphone Assembly: Include the following items:
1. Mounting cabinet which occupies 1 module location on inner door of INCC.
 2. Interconnect cable for connection of microphone to INI-VG.
 3. 1 noise canceling microphone with push-to-talk button.
- K. Addressable Node Expander (ANX):
1. Addressable Node Expander shall provide interconnection between the Fire Alarm Control Panel networks.
 2. ANX-MR-FO (Addressable Node Expander Multi-Ring with Fiber Optic connectors) and ANX-MR-UTP (Addressable Node Expander Multi-Ring with Fiber Optic and Twisted Pair connectors) shall expand the E3 Series network from 64 nodes to 122 nodes. ANX-SR (Addressable Node Expander Single Ring) will function in single 64 node systems.
- L. Network Repeater Module (RPT-E3):
1. Intelligent Network Interface shall provide interconnection and protection of remote INCC Command Centers and Transponders. Repeater shall regenerate and condition token passing, 625 K baud signal between units. Repeater shall be available in wire, or wire/fiber configurations as determined by field conditions.
 2. Interface shall have jumper to allow selection of ground detection of wiring when used in wire mode. Interface shall have integral LEDs to display current status of board.
 3. Fiber configurations shall use:
 - a. Multi-Mode ST-type connectors with a maximum attenuation of 8db with 62.5/125-micron cable.
 - b. Single-Mode LC-style connector with a maximum attenuation of 30db with 9/125-micron cable.
- F. Network Graphic Annunciator (NGA): Network able, 1/4 VGA, touch-screen annunciator with the following characteristics:
1. Custom Graphics: Panel shall permit uploading of custom bit-mapped graphic to display screen. Graphic shall display when all systems are normal.
 2. Intuitive Functions: In alarm or trouble condition, annunciator shall display only information pertaining to event, including control switches.
 - a. Trouble Condition: Display shall indicate cause of trouble. Only controls available to operator shall be Acknowledge and Reset functions.

- b. Alarm Condition: Display shall indicate cause of alarm. Only controls available to operator shall be Acknowledge, Silence, and Reset functions.

2.4 INTELLIGENT NETWORK TRANSPONDER (INX)

- A. System shall be of multiprocessor design to allow maximum flexibility of capabilities and operation. INX shall receive, transmit, and regenerate voice, fire fighter phones, and data over single pair of wire or fiber optic cable.
- B. INX shall provide full multi-channel distributed voice messaging, with integrated switching amplification, and SLC and extended phone riser. INX shall communicate with network system in true peer-to-peer fashion operating at 625 K baud over any combination of fiber or wire media. INX shall consist of the following units and components.
- C. System Cabinet: System cabinet shall be surface or semi-flush mounted with texture finish and shall consist of 4 parts, back box, back plate, inner door, and outer door. System cabinet houses INI-VG, PM-9 power supply, up to 4 - AM50, microphone, and related circuitry.
- D. Intelligent Network Interface Voice Gateway (INI-VG): INI-VG shall be a multi-function board interchangeable in both INCC and INX. Functions of board shall include the following features as a minimum:
 - 1. Network interface operating at 625 K baud configurable with any combination of wire and/or fiber topologies. Interface shall communicate with up to 122 total INCC, INX, and E3 and S3 control panels in peer-to-peer fashion.
 - 2. Fire Fighter Phone Riser: INI-VG shall generate local phone riser for use with AOM-TEL phone modules for connection to fire fighter phone. INI-VG shall mix its local phone riser to network in true Style 7 fashion.
 - 3. Signaling Line Circuit (SLC): INI-VG shall generate local SLC to communicate with and control up to 16 AOM-TEL modules and 32 AOM-2S or AOM-MUX circuits for fire phone interfacing and additional split-speaker circuits.
 - 4. RS-485: Provide capability to communicate with up to 16 ASM-16 modules, when used in INX mode up to 3,000 feet.
 - 5. Advanced Processing: INI-VG shall incorporate latest in digital signaling processing technology with supporting Boolean logic including AND, OR, NOT, TIME DELAY functions.
 - 6. Voice Generation: INI-VG shall incorporate all processing to allow for 16 distinct pre-recorded messages used in priority fashion with message 1 as highest priority. Total length for 1 to 16 messages shall be up to 3 minutes.
- E. Power Supply Module (PM-9): PM-9 power supply shall supply all power necessary under normal and emergency conditions. Power supply shall provide capacity to charge up to 55 amp-hour batteries while under full load. Technology used shall be of power-saving switching configuration, eliminating need of stepping transformer.
- F. Audio Amplifier (AM-50): Include as a minimum, the following features:
 - 1. 50-watt switching audio amplifier:

- a. AM-50-25 amplifier produces 25V_{RMS} at 50 watts digital audio output.
 - b. AM-50-70.7 amplifier produces 70V_{RMS} at 50 watts digital audio output.
- 2. 2 individually addressable speaker circuits, each with capability of handling part or all of 50-watt supplied power.
- 3. Power shall be 24 VDC supplied via terminal block from local PM-9 power supply.
- 4. Ability to select from 1 of 16 pre-programmed messages in INI-VG, and paging from locally or from INCC Command Center.
- 5. Back-up amplification configurable so 1 AM-50 can perform back-up or 3, or perform 1-to-1 back-up if configured to do so in programming.
- 6. Status LEDs to indicate normal operation and trouble condition.

2.5 PRINTERS

- A. Printers: Automatic type, printing code, time, date, location, category, and condition.
 - 1. Provide hard-copy printout of all changes in status of system and time-stamp such printouts with current time-of-day and date.
 - 2. Standard carriage with 80 characters per line.
 - 3. Use standard pin-feed paper.
 - 4. Enclose in separate enclosure suitable for placement on desktop or table.
 - 5. Communicate with control using interface complying with EIA-232-D.
 - 6. Power: 120 VAC at 60 Hz.

2.6 SUPPLEMENTAL NOTIFICATION APPLIANCE CIRCUIT (HPF24)

- A. Supplemental Notification Appliance Circuit (HPF24) shall be Model HPF24S8 offering 8.0 amps (6.0 amps continuous) of regulated 24-volt power. HPF24 shall include the following features:
 - 1. Integral Charger: Charge up to 18.0 amp-hour batteries and support 60-hour standby.
 - 2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or relay.
 - 3. Surface-mount back box.
 - 4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
 - 5. Power limited circuitry in accordance with applicable UL standards.
 - 6. Operates as sync follower or a sync generator.
- B. Supplemental Notification Appliance Circuit (HPFF) shall be Model HPFF8 offering up to 8.0 amps (8.0 amps continuous) of regulated 24-volt power. HPFF shall include the following features:
 - 1. Integral Charger: Charge up to 18.0 amp-hour batteries and support 60-hour standby.
 - 2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or relay.
 - 3. Surface-mount back box.
 - 4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
 - 5. Power limited circuitry in accordance with applicable UL standards.
 - 6. Operates as sync follower or a sync generator.
- C. Supplemental Notification Appliance Circuit (GFPS) shall be Model GFPS-9 offering 9.0 amps (12.0 amps continuous) of regulated 24-volt power. GFPS shall include the following features:

1. Integral Charger: Charge up to 35.0 amp-hour batteries and support 60-hour standby.
2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or relay.
3. Surface-mount back box.
4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
5. Power limited circuitry in accordance with applicable UL standards.
6. Operates as sync follower or a sync generator

2.7 SYSTEM PERIPHERALS - Velociti

A. Addressable Devices – General:

1. Provide address-setting means using rotary-decimal switches.
2. Use simple to install and maintain decade-type (numbered 0 to 15) address switches by using standard screwdriver to rotate 2 dials on device to set address. Devices which use binary address set via dipswitch packages, handheld device programmer, or other special tools for setting device address shall not be acceptable.
3. Detectors: Analog and addressable. Connect to fire alarm control panel's Signaling Line Circuits.
4. Addressable Thermal and Smoke Detectors: Provide 2 status LEDs. Both LEDs shall flash under normal conditions, indicating detector is operational and in regular communication with control panel, and both LEDs shall be placed into steady illumination by control panel, indicating alarm condition has been detected. If required, flashing mode operation of detector LEDs can be programmed off via fire control panel program.
5. Fire Alarm Control Panel: Permit detector sensitivity adjustment through field programming of system. Sensitivity can be automatically adjusted by panel on time-of-day basis.
6. Using software in INCC Command Center, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. Detectors shall be listed by UL as meeting calibrated sensitivity test requirements of NFPA 72, Chapter 7.
7. Detectors shall be ceiling-mounted and shall include separate twist-lock base with tamper-proof feature.
8. Following bases and auxiliary functions shall be available:
 - a. Standard base with remote LED output.
 - b. Sounder base rated at 85 dBA minimum.
 - c. Intelligent Addressable Sounder base rated at 75 dBA minimum.
 - d. Form-C relay base rated 30 VDC, 2.0 A.
 - e. Isolator base.
9. Detectors shall provide test means whereby they will simulate alarm condition and report that condition to control panel. Such test shall be initiated at detector itself by activating magnetic switch or initiated remotely on command from control panel.
10. Detectors shall store internal identifying type code that control panel shall use to identify type of device (ION, PHOTO, THERMAL).

B. Addressable Manual Stations (MS-7AF):

1. Manual Fire Alarm Stations: Non-code, non-break glass type, equipped with key lock so they may be tested without operating handle.
 2. Operated Station: Visually apparent, as operated, at a minimum distance of 100 feet (30.5 m) from front or side.
 3. Stations shall be designed so after actual activation, they cannot be restored to normal except by key reset.
 4. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on cover. The word FIRE shall appear on front of stations in raised letters, 1.75 inches (44 mm) or larger.
 5. Addressable manual stations shall, on command from control panel, send data to panel representing state of manual switch and addressable communication module status.
- C. Intelligent Thermal Detectors (ATD-RL2F): Intelligent addressable devices rated at 135 degrees F (58 degrees C) and have rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. Connect via 2 wires to fire alarm control panel signaling line circuit.
- D. Intelligent Photoelectric Smoke Detectors (ASD-PL2F): Use photoelectric (light-scattering) principal to measure smoke density and shall, on command from control panel, send data to panel representing analog level of smoke density.
- E. Intelligent Ionization Smoke Detectors (ASD-IL2F): Use dual-chamber ionization principal to measure products of combustion and shall, on command from control panel, send data to panel representing analog level of products of combustion.
- F. Intelligent Multi-Criteria Acclimating Detectors (MCS-ACCLIMATE2F):
1. Addressable device designed to monitor a minimum of photoelectric and thermal technologies in single-sensing device. Include ability to adapt to its environment by utilizing built-in microprocessor to determine its environment and choose appropriate sensing settings. Allow wide sensitivity window, with no less than 1 to 4 percent per foot obscuration. Utilize advanced electronics that react to slow smoldering fires and thermal properties within single sensing device.
 2. Microprocessor: Capable of selecting appropriate sensitivity levels based on environment type it is in, such as office, manufacturing, or kitchen, and then have ability to automatically change setting as environment changes, as when walls are moved or as occupancy changes.
 3. Intelligent multi-criteria detection device shall include ability to combine signal of thermal sensor with signal of photoelectric signal to react hastily in event of fire situation. Include inherent ability to distinguish between fire condition and false alarm condition by examining characteristics of thermal and smoke sensing chambers and comparing them to database of actual fire and deceptive phenomena.
- G. Intelligent 4 Element Multi-Criteria Detectors (MCS-4-WARN):
1. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical carbon monoxide (CO) sensor, a daylight-filtered infrared sensor and solid-state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
 2. The intelligent multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in an effort to react

quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The product design shall be capable of selecting the appropriate sensitivity levels based on the environment type chosen by user in which it is installed (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes.

3. The detector shall indicate CO trouble conditions including 6 months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.
4. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There are three test methods: functional magnet, smoke entry aerosol, or direct heat method.

H. Intelligent Fire/Carbon Monoxide Detectors (MCS-COF):

1. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid-state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
2. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.
3. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.
4. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.

I. Intelligent Laser Detectors (ASD-LS): Sensor device designed to use laser diode similar to the way photoelectric sensor uses LEDs inside of sensing chamber. Detector design shall allow wide sensitivity window, with no less than 0.2 to 4 percent per foot obscuration. Detector shall be used as indicated in special application clean-room-type environments only.

J. Intelligent Aspiration Smoke Detector (AAD-8100):

1. The AAD-8100 shall offer Very Early Warning Smoke Detection, Early Warning Smoke Detection and Standard Smoke Detection settings.
2. It shall be tested and approved for coverage up to 8,000 sq. ft.
3. The ASD shall have dual source (blue LED and infra-red laser) optical smoke detection for a wide range of fire detection with enhanced immunity to nuisance particulates.
4. The ASD shall operate in air flows from 0-4000 ft/min (0-1,219 m/min).

5. PipeIQ software shall provide pipe design, FFAST system configuration, and FFAST system monitoring in a single software program.
6. The ASD shall allow 5 programmable alarm levels with time delays, including Alert, 1, Action 2, Fire 1, and Fire 2.
- Action
- K. Intelligent Duct Smoke Detector Base (DNR, DNRW):
1. In-Duct Smoke Detector Housing: Use ASD-PL2F intelligent photoelectric detector, ASD-PL2FR intelligent remote test photoelectric detector or ASD-IL2F intelligent ionization detector, which provides continuous analog monitoring and alarm verification from panel.
 2. When sufficient smoke is sensed, alarm signal is initiated, and appropriate action taken to shut down or change over air handling systems to help prevent rapid distribution of toxic smoke and fire gases throughout areas served by duct system.
 3. Duct Smoke Detectors Mounted Above Ceiling or Otherwise Obstructed from Normal View: Provide with remote alarm indicator.
 4. Each Detector: Install in either supply side or return side duct in accordance with local mechanical code.
- L. Addressable Dry Contact Monitor Modules (AMM-2F):
1. Provide to connect 1 supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in standard deep electrical box.
 3. IDC Zone: Suitable for Style B operation.
- M. Addressable Dry Contact Monitor Modules (AMM-4F):
1. Provide to connect 1 supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in 4-inch (102-mm) square, 2-1/8-inch (54-mm) deep electrical box.
 3. IDC Zone: Suitable for Style D or Style B operation.
 4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- N. Addressable Dry Contact Monitor Modules (AMM-2IF):
1. Provide to connect 2 supervised IDC zones of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box.
 3. IDC Zones: Suitable for Style B operation.
 4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- O. Addressable Two Input and Two Output Modules (AMM-2RIF):
1. Provide two isolated sets of Form-C contacts, which operate as a single pole double throw switch. The module shall allow the control panel to switch these contacts on command. The module shall not provide supervision for the notification appliance circuit (NAC). Module shall have both normally open and normally closed connections available for field wiring. Two input modules shall connect two supervised initiating device circuit (IDC) or zone of conventional alarm initiating devices (any normally open dry contact device) to the fire alarm control panel signaling line circuit (SLC) Loop.

2. Mount in 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box.
 3. IDC Zones: Suitable for Style B operation.
 4. LEDs: Four LEDs that are controlled by the panel to indicate status of each input and output. Coded signals, transmitted from the panel, can cause the LED to blink, latch on, or latch off. Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- P. Addressable Dry Contact Monitor Modules (MMI-10F):
1. Provide to connect 10 supervised Style B IDC zones or 5 supervised Style D IDC zones of conventional alarm initiating devices (any N.O. dry contact device) to 1 of the fire alarm control panel SLCs.
 2. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
 3. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- Q. Addressable 2-Wire Detector Monitor Modules (AMM-4SF):
1. Provided to connect 1 supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
 2. Mount in 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to optional surface-mounted back box.
 3. IDC Zone: Wired for Class A or B (Style D or Style B) operation.
 4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- R. 2-Wire Detector Monitor Modules (MMI-6SF):
1. Provided to connect 6 supervised Class B IDC zones of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
 2. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
 3. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
- S. Addressable Control Modules (AOM-2SF):
1. Provide to supervise and control operation of 1 conventional NAC of compatible, 24-VDC powered, polarized audio/visual notification appliances or UL-listed polarized relays for fan shutdown and other auxiliary control functions.
 2. Mount in standard 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to surface-mounted back box.
 3. Control Module NAC: Wire for Style Z or Style Y (Class A/B) with up to 1 amp of inductive signal or 2 amps of resistive signal operation. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
 4. Audio/Visual Power: Provide by separate supervised power circuit from main fire alarm control panel or from supervised, UL-listed remote power supply.
- T. Addressable Control Modules (MMO-6SF):
1. Provide to supervise and control operation of 1 conventional NAC of compatible, 24-VDC powered, polarized audio/visual notification appliances or UL-listed polarized relays for fan shutdown and other auxiliary control functions.

2. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
3. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.
4. Control module NAC: Wire for Style Z or Style Y (Class A/B) with up to 1 amp of inductive signal or 2 amps of resistive signal operation. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
5. Audio/Visual Power: Provide by separate supervised power circuit from main fire alarm control panel or from supervised, UL-listed remote power supply.

U. Addressable Relay Modules (AOM-2RF):

1. Provide two isolated sets of Form-C contacts, which operate as a double pole double throw switch. The module shall allow the control panel to switch these contacts on command. The module shall not provide supervision for the notification appliance circuit (NAC). Module shall have both normally open and normally closed connections available for field wiring.
2. Available for HVAC control and other building functions. Relay shall have 2 Form C sets of contacts that operate in tandem and are rated for a minimum of 2.0 amps resistive or 1.0 amps inductive. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
3. Mount in standard 4-inch (101.6-mm) square, 2-1/8-inch (54-mm) deep electrical box or to surface-mounted back box.
4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.

V. Addressable Relay Modules (MMO-6RF):

1. Provide six isolated sets of Form-C contacts, which operate as a double-pole double-throw switch. The module shall allow the control panel to switch these contacts on command. The module shall not provide supervision for the notification appliance circuit (NAC). Module shall have both normally open and normally closed connections available for field wiring.
2. Available for HVAC control and other building functions. Relay shall be Form C and rated for a minimum of 2.0 amps resistive or 1.0 amps inductive. Relay coil shall be magnetically latched to reduce wiring connection requirements and to ensure 100 percent of all auxiliary relay or NACs shall be energized at same time on same pair of wires.
3. Mount in factory-supplied MBB-2 or MBB-6 enclosure.
4. LEDs: Flash under normal conditions, indicating monitor module is operational and in regular communication with control panel.

W. Isolator Modules (M500X):

1. Provide to automatically isolate wire-to-wire short circuits on SLC Class A or Class B branch. Isolator module shall limit number of modules or detectors that may be rendered inoperative by short-circuit fault on SLC loop segment or branch. At least 1 isolator module shall be provided for each floor or protected zone of building. No more than 25 devices shall be connected to 1 isolator module.

2. If wire-to-wire short occurs, isolator module shall automatically open-circuit (disconnect) SLC. When short-circuit condition is corrected, isolator module shall automatically reconnect isolated section.
 3. Does not require address-setting, and its operations shall be totally automatic. Not necessary to replace or reset isolator module after normal operation.
 4. Mount in standard 4-inch (101.6-mm) deep electrical box or in surface-mounted back box.
 5. Single LED: Flash to indicate isolator is operational and illuminate steadily to indicate short-circuit condition has been detected and isolated.
- X. Conventional Heat Detectors:
1. Combination rate-of-rise and fixed temperature rated at 135 degrees F (57.2 degrees C) for areas where ambient temperatures does not exceed 100 degrees F (37.7 degrees C), and 200 degrees F (93.3 degrees C) for areas where temperature does not exceed 150 degrees F (65.5 degrees C).
 2. Low profile, ceiling-mount type with positive indication of activation.
 3. Rate-of-Rise Element: Air chamber, flexible metal diaphragm, and factory-calibrated, moisture-proof, trouble-free vent, and operate when rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
 4. Fixed-Temperature Element: Fusible-alloy retainer and actuator shaft.
 5. Smooth Ceiling Rating: 2,500 square feet (762 m²).
- Y. Conventional Photoelectric Area Smoke Detectors:
1. 24-VDC, 2-wire, ceiling-mounted, light-scattering type using LEDs light source.
 2. Each Detector: Remote LEDs output and built-in test switch.
 3. Provide on twist-lock base.
 4. Perform calibrated sensitivity and performance test on detector without need for generation of smoke. Test method shall test all detector circuits.
 5. Visual Indication of Alarm: Provide by dual-latching LEDs on detector, seen from ground level over 360 degrees. LEDs shall flash every 10 seconds, indicating power is applied to detector.
 6. Detector shall not go into alarm or trouble when exposed to air velocities of up to 3,000 feet (914.4 m) per minute.
 7. Detector Screen and Cover Assembly: Easily removable for field cleaning of detector chamber.
 8. Field-Wire Connections: Made to base through use of clamping plate and screw.
- Z. Conventional Ionization-Type Smoke Detectors:
1. 2-wire, 24-VDC type using dual uni-polar chamber.
 2. Each Detector: Remote LEDs output and built-in test switch.
 3. Provide on twist-lock base.
 4. Perform calibration sensitivity and performance test on detector without need for generation of smoke.
 5. Visual Indication of Alarm: Provide by dual-latching LEDs over 360 degrees, on detector, seen from ground level. LEDs shall flash every 10 seconds, indicating power is applied to detector.
 6. Detector shall not alarm or trouble when exposed to air velocities of up to 1,200 feet (365.76 m) per minute.

7. Detector Screen and Cover Assembly: Easily removable for field cleaning of detector chamber.
8. Field-Wire Connections: Made to base through use of clamping plate and screw.

AA. Addressable Projected Beam Detectors (ABD-2F, ABD-RT2F):

1. Single-ended, reflective design.
 2. Six user-selectable sensitivity levels.
 3. Operates in range from 16 feet to 328 feet.
 4. Temperature Range of Device: Minus 22 degrees F to 131 degrees F.
 5. Beam Detector: Automatic gain control to compensate for gradual signal deterioration from dirt accumulation on lenses.
 6. UL Listed.
 7. Ability to be tested using calibrated test filters or magnet-activated remote test station.
-
6. Entire Installed Assembly: Tamper proof and arranged to cause switch operation if housing cover is removed or if unit is removed from mounting.
 7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.

2.8 SYSTEM PERIPHERALS – E3 SERIES

A. Graphic Annunciator (Uses ANU-48 Serial Driver Board):

1. Communicate to fire alarm control panel via EIA-485 (multi-drop) 2-wire communications loop. Up to 16 annunciator drivers, each configured up to 48 points, shall be connected per SLP panel locally, or up to 3,000 feet from the Control Panel.
2. ANU-48: Provide interface to approved UL-listed graphic-style LED annunciator and provide each of the features specified.

B. Auxiliary Switch Module (ASM-16):

1. Each ASM-16 has 16 programmable push-button switches.
2. Each push-button switch has 3 associated status LEDs (red, yellow, and green), configurable to indicate any combination of functions.
3. Flexible switch configurations to allow auxiliary functions.
4. An insertable label to identify function of each switch and LEDs combination.
5. Provide capability to communicate with up to 16 ASM-16 modules locally, or up to 3,000 feet from the Control Panel.

C. LCD Display Annunciator:

1. Furnish and install as indicated on the Drawings a remote serial annunciator, Model LCD-7100. Annunciator shall provide 80-character display, which shall duplicate all information on basic system display, including any network nodes its host panel is annunciating, with exception of menus. Contain the following function keys:
 - a. Alarm Acknowledge.
 - b. Trouble Acknowledge.

- c. Signal Silence.
- d. System Reset/Lamp Test.
- e. System Drill Test.
- 2. Key Lock: Enable switches only when placed in "ON" position, with exception of Trouble Acknowledge, which is used to silence local trouble audible sounder. Annunciator shall contain the following LEDs:
 - a. Alarm.
 - b. Supervisory.
 - c. System Trouble.
 - d. Power Fault.
 - e. System Silenced.
- 3. Mount on standard 3-gang surface or flush electrical box.
- 4. Each ILI-MB-E3/ILI-MB-E3: Accommodate up to 5 remote LCD-7100 annunciators which shall be located up to 3,000 feet from control panel.

D. NGA Network Graphic Annunciator

- 1. Main Menu
 - a. Configure allows Auto-configuration of ILI-MB-S/ and ILI-MB-E3/ILI-S-E3 and NGA or ANX.
 - b. Walk/Drill enables Walk Test and Fire Drill function.
 - c. I/O Allows enable/disable input and output devices.
 - d. Clock system real-time clock.
 - e. View system configuration information
 - f. NGA log displays, stores, prints and clears the 4100-event history log.
 - g. Service provides Network Query functions.
 - h. (More spec items – Text messaging, custom logo, custom screensaver, max amount of text on screen at one time)

E. Portable Emergency Telephone Handset Jacks:

- 1. Flush mount on stainless steel plates as indicated on the Drawings.
- 2. Approved for emergency telephone system application.
- 3. Insertion of remote handset plug into jack shall send signal to fire INCC Command Center which shall audibly and visually indicate on-line condition and sound a ring indication in handset.
- 4. 2-Way Emergency Telephone System: Support a minimum of five (5) handsets on line without degradation of signal
- 5. Cabinet: Provide in fire control room to house 10 portable handsets.

F. Fixed Emergency Telephone Handsets:

- 1. Telephone Cabinets:
 - a. Paint red and clearly label emergency telephone.
 - b. Locate as indicated on the Drawings.
 - c. Key same as INCC Command Center, INX Transponders, and manual stations.
- 2. Handset Cradle: Cam-operated microswitch connection such that lifting handset off cradle sends signal to fire INCC Command Center which shall audibly and visually indicate on-line (off-hook) condition. Open blade finder contacts shall not be acceptable.

3. 2-Way Emergency Telephone System: Support a maximum of five 5 handsets on line (off hook) without degradation of signal.

G. Speakers:

1. Operate on 25 VRMS or 70.7 VRMS with field-selectable output taps from 0.5 to 2.0 watts.
2. Speakers in Corridors and Public Spaces: Produce nominal sound output of 84 dBA at 10 feet (3 m).
3. Frequency Response: Minimum of 400 Hz to 4,000 Hz.
4. Back of Each Speaker: Sealed to protect speaker cone from damage and dust.

H. Strobes:

1. Compliance: ADA and UL 1971.
2. Maximum Pulse Duration: 0.2 second.
3. Strobe Intensity: UL 1971.
4. Flash Rate: UL 1971.
5. Strobe Candela Rating: Determine by positioning selector switch on back of device.

I. Speaker/Strobes:

1. Operate on 25 VRMS or with field-selectable output taps from 0.5 to 2.0 watt
2. Speakers in Corridors and Public Spaces: Produce nominal sound output of 84 dBA at 10 feet (3 m).
3. Frequency Response: Minimum of 400 Hz to 4,000 Hz.
4. Back of Each Speaker: Sealed to protect speaker cone from damage and dust.
5. Audibility: NFPA 72.
6. Maximum Pulse Duration: 0.2 second.
7. Strobe Intensity: UL 1971.
8. Flash Rate: UL 1971.
9. Strobe Candela Rating: Determine by positioning selector switch on back of device.

J. Carbon Monoxide Alarm Notification Devices:

- A. Color of notification appliances shall be red, unless otherwise noted by District.
- B. All alarm notification devices shall be synchronized throughout the school campus building.
- C. Strobe Lights: Provide recessed mounted strobe light assembly suitable for use in electrically supervised circuit. Lamps shall be xenon flashtube type, powered from the fire alarm control panel alarm signaling circuit. Strobes shall provide candela ratings as indicated on the drawing's candelas and flash 60 times per minute unless otherwise noted. Strobes in toilets shall provide a minimum of 15 candelas. Lamps shall be protected by a clear polycarbonate lens. Housing shall be labeled "ALERT" in white vertical lettering.

- D. Horns/Strobes: Provide recessed mounted, grille face, vibrating diaphragm type, audio alarm devices consisting of an electro-mechanical horn suitable for use in an electrically supervised circuit. Horn/Strobes shall be provided with a red, tamper resistant grill. Horn shall have a minimum sound rating of 90 DBA at 10 feet and have field selectable sound levels. Horns shall be capable of providing a synchronized, field selectable, four pulse temporal pattern. Horns shall have a separate minimum candela as shown on the drawings and flash 60 times per minute unless otherwise noted. Lamps shall be protected by a clear polycarbonate lens. Housing shall be labeled "ALERT" in white vertical lettering.
- E. Horns: Provide recessed mounted, grille face, vibrating diaphragm type, audio alarm devices consisting of an electro-mechanical horn suitable for use in an electrically supervised circuit. Horns shall be provided with a red, tamper resistant grill. Horn shall have a minimum sound rating of 90 DBA at 10 feet and have field selectable sound levels. Horns shall be capable of providing a synchronized, field selectable, four pulse temporal pattern. Horns shall have a separate screw terminal for each conductor connection.
- F. Exterior Horns: Provide recessed mounted, grille face, vibrating diaphragm type, audio alarm devices consisting of an electro-mechanical horn suitable for use in an electrically supervised circuit. Horns shall be provided with a red, tamper resistant grill, and a weatherproof backbox. Horn shall have a minimum sound rating of 90 DBA at 10 feet and have field selectable sound levels. Horns shall be capable of providing a synchronized, field selectable, four pulse temporal pattern. Horns shall have a separate screw terminal for each conductor connection. Horns located in areas subject to moisture or exterior atmospheric conditions, shall be approved for such locations.
- G. Field Charging Power Supply (FCPS):
1. The FCPS is a device designed for use as either a remote 24-volt power supply or used to power Notification Appliances.
 2. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24-volt power. It shall include an integral charger designed to charge 7.0-amp hour batteries and to support 60-hour standby.
 3. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
 4. The FCPS shall include an attractive surface mount backbox.
 5. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.

The FCPS include power limited circuitry, per 1995 UL standards

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive fire alarm system.
 - 1. Notify Architect of conditions that would adversely affect installation or subsequent use.
 - 2. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Install fire alarm system in accordance with NFPA 72, NFPA 70, state and local codes, manufacturer's instructions, and as indicated on the Drawings.
- B. Conceal conduit, junction boxes, and conduit supports and hangers in finished areas. Conceal or expose conduit, junction boxes, and conduit supports and hangers in unfinished areas.
- C. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.
- D. Flush-mount fire detection and alarm system devices, control panels, and remote annunciators in finished areas. Flush-mount or surface-mount fire detection and alarm system devices, control panels, and remote annunciators in unfinished areas.
- E. Ensure manual stations are suitable for surface mounting or semi-flush mounting as indicated on the Drawings. Install not less than 42 inches, nor more than 48 inches, above finished floor measured to operating handle.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide service of competent, factory-trained technician authorized by manufacturer to technically supervise and participate during pre-testing and acceptance testing of system.
- B. Testing:
 - 1. Conduct complete visual inspection of control panel connections and test wiring for short circuits, ground faults, continuity, and insulation before energizing cables and wires.
 - 2. Close each sprinkler system control valve and verify proper supervisory alarm at INCC Command Center.
 - 3. Verify activation of flow switches.

4. Open initiating device circuits and verify that trouble signal actuates.
5. Open signaling line circuits and verify that trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground initiating device circuits and verify response of trouble signals.
8. Ground signaling line circuits and verify response of trouble signals.
9. Ground notification appliance circuits and verify response of trouble signals.
10. Check alert tone and prerecorded voice message to alarm notification devices.
11. Check installation, supervision, and operation of intelligent smoke detectors.
12. Introduce on system each of the alarm conditions that system is required to detect. Verify proper receipt and proper processing of signal at INCC Command Center and correct activation of control points.
13. Consult manufacturer's manual to determine proper testing procedures when system is equipped with optional features. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality, and similar.

C. Acceptance Testing:

1. Before installation shall be considered completed and acceptable by AHJ, a complete test using as a minimum, the following scenarios shall be performed and witnessed by representative approved by Engineer. Monitoring company and/or fire department shall be notified before final test in accordance with local requirements.
2. Contractor's job foreman, in presence of representative of manufacturer, representative of Owner, and fire department shall operate every installed device to verify proper operation and correct annunciation at control panel.
3. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.
4. Completely disconnect INCC Command Center from rest of network, including Voice INCC Command Center. Activate initiating device from transponder. All speaker circuits activated from each transponder shall transmit the correct evacuation or alert message. These messages shall be same messages transmitted with INCC Command Center activated. Default tones or messages shall not be acceptable.
5. Completely disconnect INCC Command Center from rest of network. Activate initiating device. All control outputs supported by transponder SLC circuits shall operate under project programming mode. Default or degrade mode programming shall not be acceptable.
6. Fire fighter phone riser shall be directly shorted between INCC Command Center and first transponder, followed by test of fire phones between INCC Command Center and farthest transponder. Phones shall operate in normal fashion.
7. All audio risers shall be directly shorted between INCC Command Center and first audio transponder, followed by activation of alarm initiating device. Correct pre-recorded messages shall transmit from all speakers, including evacuation and alert channels. Default or degrade messages shall not be acceptable.
8. When testing has been completed to satisfaction of both Contractor's job foreman and representatives of manufacturer and Owner, a notarized letter co-signed by each attesting to satisfactory completion of said testing shall be forwarded to Owner and fire department.
9. Leave fire alarm system in proper working order and, without additional expense to Owner, replace defective materials and equipment provided within 1 year (365 days) from date of final acceptance by the owner.

3.4 DEMONSTRATION

- A. Provide instruction as required for operating fire alarm system.
- B. Provide hands-on demonstrations of operation of fire alarm system components and functions.

END OF SECTION

SECTION 31100
SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. Provide all material, labor, equipment and services necessary to completely clear and demolish all materials, accessories and other related items necessary to complete the Project as indicated by the Contract Documents.
- B. RELATED SECTIONS:
 - 1. Contract General Conditions and Division 1, General Requirements
 - 2. Section 312000 – Earthwork: Excavation, Filling, and Grading
 - 3. Section 312222 – Soil Materials
 - 4. Section 312333 – Trench Excavation and Backfill

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. In accordance with Specification Section GENERAL REQUIREMENTS, and the following:
 - a. Materials and equipment used for this project shall comply with the current applicable regulations of the California Air Resources Board [CARB] and the Environmental Protection Agency [EPA].
- B. Meetings:
 - 1. Minimum agenda shall be to discuss coordination of upcoming work, review the work progress, discuss field observations, identification of any potential problems which may impede planned progress; corrective measures to regain projected schedule; and maintenance of quality and work standards.
 - 2. Meetings shall include Pre-Clearing and Demolition Meetings.
 - 3. Participants (or designated representative of) invited to attend each of the above meetings shall be as follows:
 - a. Contractor.

- b. Owner.
- c. Architect.
- d. Testing Laboratory.
- e. Local Governing Authorities as applicable.
- f. Utility Representatives as applicable.
- g. Owner's Inspector.
- h. Clearing and Demolition Subcontractor.
- i. Other subcontractors, as appropriate (including any accessory subcontractors).

1.4 PROJECT CONDITIONS OR SITE CONDITIONS

A. Dust Control

1. Contractor shall comply with all requirements of the San Joaquin Valley Air Pollution Control District (SJVAPCD) for construction activity related to this project.
2. A Dust Control Plan, as required by the SJVAPCD, may be required for this project. Contractor shall be responsible for preparing said Dust Control Plan, submitting to the SJVAPCD for review and approval, and paying all SJVAPCD review and permitting fees related to the Dust Control Plan.
3. No construction activity related to this project may begin until Contractor has secured an approved Dust Control Plan, if one is required.
4. Contractor shall be solely responsible to implement all requirements of the Dust Control Plan throughout the life of this contract.
5. Should fines or fees be levied against the Project for violations of the Dust Control Plan and/or related SJVAPCD regulations, Contractor shall be responsible to pay all said fines or fees and to implement all mitigation measures required by SJVAPCD in order to bring the construction activity into compliance with SJVAPCD regulations. The costs for any such fines or fees shall be included in the lump sum price bid for work under this contract and no additional payment will be made therefor.

B. Existing Conditions:

1. Examine site and compare it with the drawings and specifications. Thoroughly investigate and verify conditions under which the work is to be performed. No allowance will be made for extra work resulting from negligence or failure to be acquainted with all available information concerning conditions necessary to estimate the difficulty or cost of the work.
2. Conduct work so as not to interfere unnecessarily with adjacent roads, streets, drives, walks or occupied facilities.
 - a. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and Authorities having jurisdiction.
 - b. Provide alternate routes around closed or obstructed traffic ways if required by Authorities having jurisdiction.
3. Locate and identify utilities.

- a. Call a Local Utility Locator Service (USA – “Underground Service Alert” – [800] 227-2600) for the task of locating any applicable utilities in the area where the Project is located.
4. Carefully remove items indicated to be salvaged and store on Owner’s premises at the Owner’s direction.

PART 2 - PRODUCTS

(NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordination:

1. Coordinate work under this specification section with work specified under other sections to ensure proper and adequate interface of work.

B. Protection:

1. Protect and maintain all benchmarks and survey control points from disturbance during clearing and demolition operations.
2. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties.
3. Furnish and install temporary protection/barrier fencing surrounding the limits of demolition.
4. Protect trees, plant growth, and features not specifically designated for removal. Locate and clearly flag trees and vegetation to remain or to be relocated.
5. Protect existing improvements designated to remain from damage during construction.
 - a. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.2 CONSTRUCTION

A. Vegetation, Shrub, Topsoil, Weed Removal:

1. Remove weeds and rooted topsoil to a minimum four (4) inch depth and temporarily stockpile as needed for re-use in finished grading of landscape areas. Remove excess material from the site.
2. Where existing vegetation is to be replaced by new materials, remove contaminated or excess soil from the site and legally dispose of off-site.

B. Existing Site Improvements Removal:

1. Remove existing above and below grade improvements as necessary to facilitate new construction.
 - a. Remove concrete slabs, sidewalk, curbs, mow strips, gutters, and fence post footings.
 - 1) Neatly saw-cut length of existing pavement to remain before removing existing pavement unless existing full-depth joints coincide with line of demolition. Saw-cut faces vertically.
 - b. Remove indicated utility improvements within the limits of construction.
 - 1) Excavate for and disconnect utilities designated to be removed. Seal or cap off underground.
 - 2) Coordinate removal and/or relocation of utilities with the appropriate utility agencies.
 - c. Where existing underground utilities, irrigation pipes, wells, leach fields, or underground tanks are encountered, they must be removed or moved to a point at least 5 feet horizontally outside the proposed building and 3 feet horizontally outside the concrete flatwork or pavement construction areas. All resultant cavities must be backfilled with engineered fill.
 - d. Remove concrete slabs, foundations, and utilities within building footprint.
- C. Existing Utilities to Remain or be Relocated:
 1. 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:
 - a. Notify Architect and the Owner not less than seven (7) days in advance of proposed utility interruptions.
 - b. Arrange to shut off indicated utilities with utility companies and Owner.
- D. Disposal:
 1. Legally dispose of all debris (surplus soil materials, unsuitable topsoil, obstructions, demolished materials, waste materials, trash, etc.) resulting from clearing, grubbing, demolition and from construction. Disposal of all materials shall be at a location secured by the Contractor off of the Owner's property.

END OF SECTION

SECTION 312000
EARTHWORK: EXCAVATION, FILLING AND GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Excavating soil and other material for surface improvements.
 - 2. Placing fill.
 - 3. Compaction of existing ground and fill.
 - 4. Preparation of subgrade for other improvements.
 - 5. Grading of soil.
- B. RELATED SECTIONS
 - 1. Contract General Conditions and Division 1, General Requirements
 - 2. Section 311100 – Site Clearing
 - 3. Section 312222 – Soil Materials
 - 4. Section 312333 – Trench Excavation and Backfill

1.3 REFERENCES

- A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18-inch (457 mm) Drop.
- B. A Geotechnical Engineering Investigation Report has been prepared for the project by Technicon Engineering Services, Inc.; Technicon Project No. 240282.001, dated June, 12, 2024. A copy of the report is available (for reference only) at the cost of reproduction. Contact Technicon Engineering Services, Inc. consultants if a copy of the report is desired.

1.4 DEFINITIONS

- A. Utility: Any buried or above ground pipe, conduit, cable, associate device or appurtenances, or substructure pertaining thereto.

1.5 SUBMITTALS

A. Product Data:

1. Information indicating the source of all import material, the fill material type and where it is to be used, and approval of the District's Inspector of Record for incorporation of import material into the Work.

B. Material Test Reports:

1. Classification of Soils.
2. Compaction Characteristics of Soils.
3. Density and Unit Weight of Soils in Place.
4. Imported fill shall be tested and approved by the Owner's Geotechnical Engineer prior to import to the site, including testing for compliance with Department of Toxic Substances Control (DTSC) guidelines. Said testing and certification documents shall be paid for by the Owner.

C. Project Closeout: In accordance with Specification Section PROJECT CLOSEOUT.

1. Drawings indicating the extent and depth of all engineered fill, and overexcavation and recompaction. This information shall be a part of the Project "As-Built" and Project "Record" Documents in accordance with the Specification Section PROJECT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Installer:

1. Qualifications:

- a. Engage an experienced Installer who has successfully completed three (3) projects of similar scope and size to that indicated for this project within the past 5 years.

B. Regulatory Requirements:

1. In accordance with Specification Section REGULATORY REQUIREMENTS and the following:
 - a. CARB Materials and equipment used for this Project shall comply with the current applicable regulations of the California Air Resources Board [CARB].
 - b. CT City of Tranquillity, Codes and Ordinances
 - c. EPA Environmental Protection Agency.
 - d. CAL/OSHA Comply with all provisions of the Construction Safety Orders and the General Safety Orders of the California Division of Occupational Safety and Health, as well as all other applicable regulations as they pertain to the protection of

- e. DTSC workers from the hazard of caving ground excavations. Comply with all recommendations of the California Department of Toxic Substance Control (DTSC) regarding soil testing for potential contaminants.

C. Certificates:

1. Installer's certification that all Earthwork installation meets or exceeds the requirements of this specification.
2. Contractor's certification (on Contractor's letterhead paper) that the Earthwork materials and installation meets or exceeds the requirements of this specification.

D. Meetings:

1. Pre-Installation: Schedule prior to the start of work.
 - a. Coordinate the work with other work being performed.
 - b. Identify any potential problems, which may impede planned progress and proper installation of work regarding quality of installation and warranty requirements.
2. Progress: Scheduled by the Contractor during the performance of the work.
 - a. Review for proper installation of work progress.
 - b. Identify any installation problems and acceptable corrective measures.
 - c. Identify any measures to maintain or regain project schedule if necessary.
3. Completion: Scheduled by the Contractor upon proper completion of the work.
 - a. Inspect and identify any problems which may impede issuance of warranties or guaranties.
 - b. Maintain installed work until the Notice of Substantial Completion has been filed.

1.7 COORDINATION

- A. Coordinate work with Owner's personnel.
- B. Provide required notification to the Owner and Geotechnical Engineer or the Engineer of Record so that a representative from the Owner's Geotechnical Engineering consultant can be present for all excavation, filling and grading operations to test and observe earthwork construction.
- C. Verify that the location of existing utilities has been indicated at work site by utility authorities, by Owner, and as specified on the Plans.

1.8 EXISTING CONDITIONS

- A. Existing Conditions:

1. Examine the site and verify conditions with the Drawings and Specifications. Contractor shall familiarize himself with existing site conditions and any changes that have occurred at the site since the preparation of the contract documents and shall be responsible to account for any such changes in the price bid for this work.
 2. Thoroughly investigate and verify conditions under which the Work is to be performed.
 3. Locate and identify utilities:
 - a. Call a Local Utility Locator Service (USA - "Underground Service Alert" – [800] 227-2600) for the task of locating any applicable off-site and on-site utilities in the area where the Project is located.
 4. No allowance for Extra Work will be granted resulting from negligence or failure to meet requirements of this Section.
- B. Where subsurface work involves more than the normal depth of excavation required for the removal and/or construction of surface improvements (surface improvements such as concrete flatwork, paving, landscaping, signs, etc.), the Engineer will have made a diligent attempt to indicate on the plans the location of all main and trunk line utility facilities which may affect the Work. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. Under similar circumstance, service laterals and appurtenances will have also been shown where information was available as to their location. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- D. Determine exact location of existing buried utilities by:
1. Marking on ground or pavement surface the alignment and extent of the facilities and the probable location of existing utilities using construction plans and existing surface features.
 2. Requesting Underground Service Alert (USA) to indicate location of existing buried facilities (phone 1-800-227-2600). Provide USA a minimum of two (2) working days notice of request for locations and notify Owner of said request concurrently.
 3. Confirm exact location of existing utilities by hand methods of excavation, or by use of vacuum equipment.
- E. At proposed work location, expose by hand methods (or vacuum equipment) all existing utilities along the route of the proposed work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand (or vacuum equipment) methods to locate all existing facilities as indicated on the plans, and/or as indicated on the ground by USA or Owner's personnel.
- F. Provide Field Engineering to record the location of all utilities encountered. Where

locational conflicts exist between existing utilities and the planned location of facilities to be constructed under this Contract, submit detailed information to the Engineer for review and direction.

- G. Maintain all existing utility mains and service lines in constant service during construction of the Work.
- H. Where service disruptions are allowed, minimize the length of such disruptions by proper scheduling and diligent pursuit of the work, and coordinate the timing of any such disruptions in advance with the District.
- I. Existing soils are considered to have a moderately corrosive potential to buried metal objects.
- J. Existing soils are considered to have a moderate to high expansion potential.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Dust control: Perform work in a manner as to minimize the spread of dust and flying particles. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of other on-site work.
 - 1. All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, or vegetative ground cover.
 - 2. All land clearing, demolition, grubbing, scraping, excavation, land leveling, grading, and cut and fill activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by pre-soaking.
 - 3. When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions or at least six inches of freeboard space from the top of the container shall be maintained.
 - 4. All operations shall limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at least once every 24 hours when operations are occurring. The use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions. The use of blower devices is expressly forbidden.
 - 5. Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/suppressant.
 - a. Contractor shall comply with all requirements of the San Joaquin Valley Air Pollution Control District (SJVAPCD) for construction activity related to this project.
 - b. A Dust Control Plan, as required by the SJVAPCD, may be required for this project. If required, Contractor shall be responsible for preparing said Dust Control Plan, submitting to the SJVAPCD for review and approval, and paying all SJVAPCD review and permitting fees related to the Dust Control Plan.
 - c. If a dust control plan is required, no construction activity related to this

project may begin until Contractor has secured an approved Dust Control Plan.

- d. Contractor shall be solely responsible to implement all requirements of the Dust Control Plan throughout the life of this contract.
- e. Should fines or fees be levied against the Project for violations of the Dust Control Plan and/or related SJVAPCD regulations, Contractor shall be responsible to pay all said fines or fees and to implement all mitigation measures required by SJVAPCD in order to bring the construction activity into compliance with SJVAPCD regulations. The costs for any such fines or fees shall be included in the lump sum price bid for work under this contract and no additional payment will be made therefore

B. Burning: No burning will be allowed on-site.

C. Rain: Work under this section shall not be started or maintained under threat of rain, unless the work is not affected by the rain.

D. Do not place fill during weather conditions which will alter moisture content of fill materials sufficiently to make compaction to the specified densities difficult or impossible.

E. When reference is made to SWPPP (Storm Water Pollution Prevention Plan), if any within this Project Manual, then comply with all environmental protection requirements included therein.

F. In accordance with EPA, CARB and CT.

G. Protection:

- 1. Protect cut and fill areas to prevent water running into excavation. Maintain areas free of water. Remove seeping water immediately by pumps. Provide dewatering as necessary.
- 2. Protect cut slopes from erosion due to precipitation and other sources of runoff.
- 3. Protect utilities to remain within the construction area and special construction. If utility lines are uncovered (water, electric, sewer, etc.) not shown on the drawings during excavation of site, notify the Architect promptly for its review and action.
- 4. Do not permit access to undeveloped portions of the site, nor to areas that are outside of the limits of grading.

H. Before being brought onto the site, all import soil must be sampled, tested and approved by Owner's Geotechnical Engineer. All import material must comply with DTSC recommendations and guidelines for environmentally clean soil suitable for school construction. Import testing will be provided and paid for by the Owner.

1.10 PROJECT RECORD DOCUMENTS

A. Submit under provisions of GENERAL CONDITIONS and DIVISION 1, GENERAL REQUIREMENTS.

B. Accurately record actual locations of utilities encountered including depth and

horizontal location, as measured from permanent site features.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill in Turf or Other Planting Areas: Type S2 or S3 per Division 31 Specification Section SOIL MATERIALS.
- B. Fill in Non-planting Areas: Type S1, S2 or S4 per Division 31 Specification Section SOIL MATERIALS.
- C. Imported material: Type S3, S4 or S5 per Division 31 Specification Section SOIL MATERIALS.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.

3.2 PREPARATION

- A. Layout of Work:
 - 1. Contractor shall be responsible for all lines and grades. Layout shall be provided by a California registered Land Surveyor or Civil Engineer, at Contractor's expense.
 - 2. Check all benchmarks, monuments and property lines and verify locations.
 - 3. Locate and maintain all grade stakes.
 - 4. Monuments moved or displaced during grading operation are to be replaced by a California Registered Civil Engineer or Surveyor, at Contractor's expense.
- B. Locate, identify, and protect existing above and below grade utilities from damage.
- C. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- D. Protect existing structures, fences, curbs, sidewalks, paving and other improvements to remain from damage from excavation equipment and vehicular traffic.
- E. Employ equipment and methods appropriate to the work site.
- F. Protect excavated areas from drainage inflow and provide for drainage of all excavated areas.
- G. Comply with all provisions of the Construction Safety Orders and General Safety Orders of the California Division of Industrial Safety, as well as all other applicable

regulations as they pertain to the protection of workers from the hazard of caving ground in excavations.

3.3 SITE STRIPPING:

- A. Reference is made to Division 31 Specification Section SITE CLEARING.
- B. Within the areas of planned surface improvements and structures, the near surface soils containing vegetation, roots, organics, or other objectionable material must be stripped and removed from the site. Upon approval of the Engineer, suitable materials stripped from the site may stockpiled and incorporated into the finish fill for planting areas.
- C. All areas to receive surface improvements shall be stripped to remove turf, shrubs, trees and other vegetation, along with associated root systems, concrete, wood, metal, rubbish and other unsuitable debris, and any loose, saturated or unconsolidated soil material. Minimum stripping depth is expected to be 3-inches below existing site grades. Stripping shall continue to the depth required to expose acceptable basement soils that are free from deleterious which are not suitable for Engineered Fill, as required by the Engineer.
- D. Surface strippings should not be incorporated into fill unless they can be sufficiently blended to result in an organic content less than 3 percent by weight (ASTM D2974). Stripped topsoil, with an organic content between 3 and 12 percent by weight, may be stockpiled and used as non-structural fill (i.e. on landscape areas). If used in landscape areas, soil with an organic content between 3 and 12 percent should be placed within 2 feet of finished grade, and at least 5 feet outside of building perimeters. Soil with an organic content greater than 12 percent by weight should be excluded from fill.

3.4 EXCAVATION

- A. Following clearing and stripping operations, excavate planned construction areas as specified in this Section.
- B. Within the area of the project site plus at least 5-feet horizontally beyond the project site, the subgrade must be over-excavated at least 2-feet below the existing stripped subgrade surface or at least 12-inches below to the bottom of the proposed footings, whichever is deeper.
- C. Provide additional excavation as required to conform to the lines, grades and cross-sections shown on the plans.
- D. When excavating through tree roots, perform work by hand and cut roots, where authorized, with a saw. Remove all roots 1/4" in diameter and greater.
- E. Remove excess soil not to be used as fill in the Work from the site. Unless requested by Owner to be deposited at a site designated by Owner on the property, obtain a disposal site and legally dispose of said excess material, all at no additional cost to the Owner.

- F. Areas disturbed by demolition must be excavated to expose undisturbed soils.
- G. Excavated soils free of deleterious substances (organic matter, demolition debris, tree roots, etc.) and with less than 3% organic content by weight, may be returned to the excavations as Engineered Fill.

3.5 FILLING AND COMPACTING

- A. Once clearing, stripping and over-excavation operations are complete, scarify the surface to receive fill material or improvements to a depth of 12-inches, moisture condition and compact per Section 3.5.F
- B. Place and compact soil to finish subgrade of improvements to be placed thereon, or to finished surface grade where no improvements are to be placed thereon.
- C. All fill required shall be placed as Engineered Fill.
- D. The Contractor shall be solely responsible for securing an acceptable source of import material as required to grade the site. Reference is made to 31 20 00 1.9.H
- E. On-site soils are suitable for re-use as Engineered Fill, providing they are cleansed of excessive organics (less than 3 percent by weight, ASTM D2974), debris, and fragments larger than three (3) inches in maximum dimension and meet the requirements of soil Type S4, Division 31 Specification Section SOIL MATERIALS.
- F. Engineered Fill shall be placed in uncompacted layers not exceeding eight (8) inches in thickness, and moisture conditioned and compacted at specified compaction below, based on ASTM Test Method D1557.

Soils		Relative Compaction (min- max)	Minimum Moisture Conditioning (% Over Optimum)
PI	EI		
<9	<20	90%	+ 0%
9-15	21-40	90-95%	+ 3%
16-25	41-80	88-92%	+ 4%
>25	>80	88-92%	+ 5%

- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. Additional lifts shall not be placed if the previous lift did not meet the required dry density (relative compaction), or if soil conditions are not stable.
- I. Conform fill to the lines, grades and cross-sections shown on the plans.
- J. Fill materials to conform to Division 31 Specification Section SOIL MATERIALS.
- K. Provide, at no additional cost to Owner, imported soil material conforming to the requirements of Division 31 Specification Section SOIL MATERIALS, as needed to attain finished grades of Work.
- L. Utilize equipment which will not disturb or damage existing utilities and other improvements.

3.6 EARTH MAT CONSTRUCTION

- A. A geogrid and gravel raft system on recompacted subgrade using geogrid (Tensar InterAx NXST or approved equal) shall be constructed beneath foundations for structures at the project site.
- B. The geogrid and gravel raft system, including fill layers, shall extend laterally beyond the perimeter of the foundations a minimum of 10-feet.
- C. The geogrid and gravel raft system shall consist of the proposed structures supported on a minimum of 12-inches of Class II aggregate base over geogrid.
- D. The gravel raft shall be placed at a uniform depth for each structure, and such that the top of the aggregate base layer coincides with the bottom depth of the deepest foundation for each structure.
- E. The geogrid shall be placed on native soil or engineered fill in accordance to the section outlined above and the Division 31 Specification Section SOIL MATERIALS and covered with Class II aggregate base compacted to at least 90 percent relative compaction and moisture conditioned at optimum moisture.

3.7 PREPARATION OF SUBGRADE FOR SURFACE IMPROVEMENTS

- A. Where concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvements, or a layer of said surface improvements, are to be constructed on the soil surface, prepare the subgrade for said improvements in accordance with this section.
- B. Scarify the soil as specified and remove and dispose of (off the project site) all rocks, hardpan chunks or otherwise unsuitable material over 3-inches in size.
- C. Thoroughly moisture condition and compact as described above.

- D. Prior to commencing construction of surface improvements, pass a test roller of size and weight as approved by the Owner over the subgrade to establish the extent of soft or spongy areas requiring repairs.
- E. Conform finished subgrade surface to the lines, grades and cross-sections shown on the plans.

3.8 FINE GRADING

- A. Fine grade all finished surfaces to the lines, grades and cross-sections shown on the plans, and to blend to hard surface improvements.
- B. Rake and smooth all finished surfaces not to receive hard surface improvements.
- C. Use suitable stockpiled or imported topsoil for the top 12-inches of areas to receive landscape improvements.
- D. Import topsoil meeting the requirements of Division 31 Specification Section SOIL MATERIALS, as required to complete finish grading.
- E. Topsoil may not be used in areas requiring Engineered Fill.

3.9 TOLERANCES

- A. Top surface of Subgrade for Non-Vegetative Surface Improvements or Layers thereof: Plus or minus 0.02 foot from planned elevation.
- B. Top surface of Subgrade for Vegetative Surface Improvements or for Bare Ground - Plus or minus 0.05 foot of planned elevation, or as required for finish surface to match adjacent improvements or ground.

3.10 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of GENERAL CONDITIONS and/or DIVISION 1, GENERAL REQUIREMENTS.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest.
- D. All retesting required as a result of failure of initial test will be performed by Owner's testing agency, at the expense of the Contractor.

3.11 PROTECTION

- A. Protect graded areas from traffic, freezing, erosion, and all other sources of damage. Keep free of debris and trash.

- B. Repair and re-establish grades to specified tolerances where completed or partially completed work becomes eroded, rutted, settled, or where it is damaged by subsequent construction operations or weather.
- C. Where settlement occurs prior to acceptance of the work, remove and replace surface improvements, excavate, replace, and re-compact in accordance with these specifications, and restore the surface improvements.

3.12 CLEANING

- A. Remove all surplus or unsatisfactory soil material, trash, and debris, and legally dispose of off of the Owner's property.

END OF SECTION

SECTION 312222
SOIL MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. Excavated (and re-used) materials and imported materials.
- B. RELATED SECTIONS
 - 1. Contract General Conditions and Division 1, General Requirements.
 - 2. Section 312000 - Earthwork: Excavation, Filling and Grading.
 - 3. Section 312333 - Trench Excavation and Backfill.

1.3 SUBMITTALS

- A. Samples: Submit, in air-tight containers, 10 lb. sample of Type S3, S4 and S5 fill to inspector.
- B. Soil Analysis: Submit for Type S3, S4 and S5 soils to be imported.
- C. Materials Source: Submit location of imported materials source. Provide materials from same source throughout the work. Change of source requires approval.
- D. For imported soil, obtain Geotechnical Engineer and District approval prior to importing.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Soil Type S1: Excavated and re-used material, graded; free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Soil Type S2: Excavated and reused material, graded; free of roots, lumps greater than one inch, rocks larger than 1/2 inch, debris, weeds and foreign matter.

- C. Soil Type S3: Imported topsoil, friable loam; reasonably free of roots, rocks larger than ½ inch, debris, weeds, and foreign matter.
- D. Soil Type S4: Imported borrow, suitable for purposes intended, meeting the following characteristics:
 - 1. Maximum Particle Size: 3"
 - 2. Percent Passing #4 Sieve: 60-100
 - 3. Percent Passing #200 Sieve: 20-50
 - 4. Expansion Index: <20
 - 5. Plasticity Index: <9
 - 6. R-Value (in paved areas): >50
 - 7. Low Corrosion Potential:
 - a. Soluble Sulfates: <2,000 mg/Kg
 - b. Soluble Chlorides: <500 mg/Kg
 - c. Soil Resistivity: >2,000 ohm-cm
 - 8. Organic content: <3% by dry weight
- E. Soil Type S5: Imported sand. Natural river or bank sand (sand equivalent greater than 30), washed; free of silt, clay, loam, friable or soluble materials, and organic matter.

2.2 SOURCE QUALITY CONTROL

- A. Inspection of imported soil will be performed by the Geotechnical Engineer, at source of import and prior to being delivered to the site.

PART 3 - EXECUTION

3.1 STOCKPILING

- A. Stockpile excavated or imported material onsite at location designated by project inspector.
- B. Stockpile excavated or imported material in sufficient quantities to meet project schedule and requirements.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- B. Dispose of excess material off-site.

END OF SECTION

SECTION 312333
TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. A Geotechnical Engineering Investigation Report has been prepared for the project by Technicon Engineering Services, Inc.; Technicon Project No. 240282.001, dated June, 12, 2024. A copy of the report is available (for reference only) at the cost of reproduction. Contact Technicon Engineering Services, Inc. consultants if a copy of the report is desired.

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. Excavating trenches, holes and pits for constructing the Work.
 - 2. Backfill and compaction.
 - 3. Providing suitable bedding and backfill material, as specified herein.
- B. RELATED SECTIONS
 - 1. Contract General Conditions and Division 1, General Requirements.
 - 2. Section 311100 - Site Clearing
 - 3. Section 312000 - Earthwork: Excavation, Filling and Grading
 - 4. Section 312222 - Soil Materials
 - 5. Section 331200 - Water Utilities
 - 6. Section 333000 - Site Sewer Systems
 - 7. Section 334000 - Storm Drainage

1.3 REFERENCES

- A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

1.4 DEFINITIONS

- A. Utility: Any buried or above ground pipe, conduit, cable, associate devices or appurtenances, or substructure pertaining hereto.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Installer:

- a. Engage an experienced Installer who has successfully completed three (3) projects of similar scope and size to that indicated for this project within the past 5 years.

B. Regulatory Requirements:

1. In accordance with Specification Section REGULATORY REQUIREMENTS and the following:

- a. CARB Materials and equipment used for this Project shall comply with the current applicable regulations of the California Air Resources Board [CARB].
- b. CT City of Tranquility, Codes and Ordinances
- c. EPA Environmental Protection Agency.
- d. CAL/OSHA Comply with all provisions of the Construction Safety Orders and the General Safety Orders of the California Division of Occupational Safety and Health, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground excavations.

C. Certificates:

1. Installer's certification that all trench backfill installation meets or exceeds the requirements of this specification.
2. Contractor's certification (on Contractor's letterhead paper) that the trench backfill materials and installation meets or exceeds the requirements of this specification.

D. Meetings:

1. Pre-Installation: Schedule prior to the start of work.
 - a. Coordinate the work with other work being performed.
 - b. Identify any potential problems, which may impede planned progress and proper installation of work regarding quality of installation and warranty requirements.
2. Progress: Scheduled by the Contractor during the performance of the work.
 - a. Review for proper installation of work progress.
 - b. Identify any installation problems and acceptable corrective measures.
 - c. Identify any measures to maintain or regain project schedule if necessary.
3. Completion: Scheduled by the Contractor upon proper completion of the work.
 - a. Inspect and identify any problems which may impede issuance of warranties or guaranties.
4. Maintain installed work until the Notice of Substantial Completion has been filed.

1.6 COORDINATION

- A. Coordinate work with Owner's personnel.
- B. Verify that the location of existing utilities have been indicated at work site by utility authorities.

1.7 EXISTING UTILITIES

- A. Where subsurface work involves more than the normal depth of excavation required for the removal and/or construction of surface improvements (surface improvements such as concrete work, paving, landscaping, signs, etc.), the Engineer will have made a diligent attempt to indicate on the plans the location of all main and trunkline utility facilities which may affect the Work. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- B. Under circumstance similar to 31 23 33/1.7A, service laterals and appurtenances will have also been shown where information was available as to their location. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. Determine exact location of existing buried utilities by:
 - 1. Marking on ground or pavement surface the alignment and extent of the proposed facilities and the probable location of existing utilities using construction plans and existing surface features.
 - 2. Requesting Underground Service Alert (USA) to indicate location of existing buried facilities (phone 1-800-227-2600). Provide USA a minimum of two (2) working days notice of request for locations, and notify Owner of said request concurrently.
 - 3. Locate exact location of existing utilities by hand methods of excavation, or by use of vacuum equipment.
- D. At proposed work location, expose by hand methods (or vacuum equipment) all existing utilities along the route of the proposed work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand (or vacuum equipment) methods to locate all existing facilities as indicated on the plans, and/or as indicated on the ground by USA or Owner's personnel.
- E. Provide Field Engineering per Contract General Conditions and Division 1 to record the location of all utilities encountered. Where locational conflicts exist between existing utilities and the planned location of facilities to be constructed under the Contract, submit detailed information to the Owner's Inspector and Engineer for review and direction.

- F. Maintain all existing utility mains and service lines in constant service during construction of the Work.
- G. Where service disruptions are allowed, minimize the length of such disruptions by proper scheduling and diligent pursuit of the work.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Fill Type S1, S2, S4 and S5, as specified in Division 31 Specification Section SOIL MATERIALS.

2.2 WARNING TAPE

- A. 6" wide warning tape shall be installed over all of the pipelines as shown on the details.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- B. Protect existing structures, fences, sidewalks, curbs, and other improvements from excavation equipment and vehicular traffic.
- C. Maintain and protect above and below grade utilities which are to remain.
- D. Comply with all provisions of the Construction Safety Orders and General Safety Orders of the California Division of Industrial Safety, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground in excavations.

3.2 EXCAVATION

- A. Excavate soil required to locate existing utilities and install the work.
- B. Use hand methods of excavation to locate existing utilities, and to excavate trenches, pits and holes in congested areas.
- C. Employ equipment and methods appropriate to the work site. Small mechanical excavators may be used only in areas where there is sufficient space so as not to damage adjacent improvements, and where the locations of all existing utilities have been determined by hand methods of excavating.
- D. Cut trenches just wide enough to enable installation and proper bedding and backfill,

and to allow inspection.

- E. Do not interfere with 45 degree (1:1) bearing splay of foundations.
- F. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose material.
- G. Excavate trenches, pits or holes bottoming in hardpan to a minimum of 6 inches below the grade for the bottom of the pipe and any couplings. No additional payment will be made for such over-excavation and refill.
- H. In all trenches or excavation sites where a firm foundation is not encountered, such as soft, spongy, or otherwise unsuitable material, remove the material to a minimum of 12 inches, or to a depth determined by the Engineer, below the bottom of the proposed pipe or structure, and backfill the space with Type S2 or S5 material containing sufficient moisture to allow compaction to 90% maximum dry density (relative compaction). Soil Type S2 shall meet requirements of Type S5. No additional payment will be made for such additional excavation or backfill.
- I. Excavate trenches to provide the design grade of the facility, or as directed by the Engineer.
- J. Stockpile excavated material to be returned to trench adjacent thereto in location which will not be detrimental to existing improvements, or pedestrian or vehicular traffic. Remove from site all unsuitable or excess material not to be used.
- K. When excavating through tree roots, perform work by hand and cut roots, where authorized, with a saw.
- L. Remove excess soil not used as backfill from the work site. Obtain a disposal site off of the Owner's property and legally dispose of said excess material, all at no additional cost to the Owner.
- M. If water is encountered during excavations, provide all dewatering measures necessary to construct improvements shown.
- N. Contractor shall make all provisions necessary, including but not limited to, shoring or sloping back trench walls as required to address sandy soils. The cost of these provisions shall be included in the lump sum amount bid for this work and no separate payment will be made therefore.

3.3 PROTECTION OF EXCAVATIONS

- A. Provide all shoring and bracing as required and those codified in local, state and federal safety regulations.
- B. Prevent water, caving or sloughing ground from entering excavations.
- C. Maintain excavations free of water.

3.4 BACKFILLING

- A. Provide type S2 or S5 pipe bedding as required by Plans and compact to 90% maximum dry density (relative compaction). Soil Type S2 shall meet requirements of Type S5.
- B. After installation of pipes and appurtenances and placement of pipe bedding material, backfill trenches and excavations to finished grade, or subgrade in areas to receive surface improvements
- C. Backfill trenches to a minimum of 12 inches above the pipe and any couplings with Type S2 or S5 material, containing sufficient moisture to allow compaction to 90% maximum dry density (relative compaction). Soil Type S2 shall meet requirements of Type S5.
- D. Backfill trenches above pipe bedding material and to within 24 inches of finish subgrade with Type S1, S2, S4, or S5 soils, except that that top 12 inches shall be type S2, S3, S4, or S5 soils.
- E. Employ a placement method that does not disturb or damage existing or proposed pipes or other Utilities or Improvements.
- F. Place and compact all soil backfill in continuous layers not exceeding 8 inches in loose uncompacted thickness, moisture condition to at least 3% above optimum moisture content.
- G. Maintain optimum moisture content of fill materials to attain required compaction.
- H. Backfill final 12-inch thickness to finish subgrade in areas to receive concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvement, with Type S2, S4, or S5 soils.
- I. Backfill final 12-inch thickness to finish subgrade in areas to receive sod, other vegetation, or bare soil, with Type S2 or S3 soils.
- J. Compact backfill below the top 12-inches to 90% maximum dry density (relative compaction).
- K. In areas to receive buildings, structures, or concrete flatwork, compact the top 12-inches to 90% maximum dry density (relative compaction).
- L. In areas to receive asphalt concrete pavement or concrete pavement subject to vehicular traffic, compact the top 12-inches to 95% maximum dry density (relative compaction).
- M. In planting areas, compact the top 12-inches to 85% maximum dry density (relative compaction).

3.5 TOLERANCES

- A. Top Surface of Backfill under Paved or Concrete Areas: Plus or minus 0.02 feet from required elevations.

- B. Top Surface of General Backfilling: As required for finish surface to match adjacent improvements or ground.

3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of General Conditions and/or Division 1.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If tests indicate work does not meet specified requirements, recompact, and retest. Retests required due to failure of initial tests shall be paid for by the Contractor.

3.7 PROGRESS AND PROSECUTION

- A. Backfill any excavation opened in any day on that same day.

END OF SECTION

SECTION 32 01 90

EXISTING LANDSCAPE PROTECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section includes but is not limited to the following:
 - 1. Protection and maintenance of existing trees and other plants that are affected by the execution of the Work, whether temporary or new construction.
- B. Related Work Specified Elsewhere
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections.
 - 2. Section 31 11 00: Site Clearing
 - 3. Section 31 20 00: Earthwork
 - 4. Section 31 23 33: Trench Excavation and Backfill
 - 5. Section 32 84 00: Irrigation System
 - 6. Section 32 90 00: Landscape Planting

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated or proposed for use.
- B. Qualification Data: Submit arborist's certification and/or license information. Submit qualifications and experience of the certified tree worker if not the arborist.
- C. Project Certification: Provide a certification letter from the consulting arborist that trees indicated to remain have had their Tree Protection Zone (TPZ) protected during construction according to these specifications and/or the arborist's recommendations. Provide a list of any trees damaged during construction and the subsequent treatment and repair.
- D. Transplanting and Maintenance Recommendations: Submit transplanting, maintenance and protection specifications from a qualified arborist for care and protection of trees during and after completion of the Work that are likely to be affected by construction operations. The tree maintenance recommendations shall be included in the Maintenance Manuals required in 329000.
- E. Tree Assessment and Valuation: Prior to the start of any construction operations of any kind, submit a tree assessment including tree valuation for existing trees scheduled to remain in the area of work or in auxiliary construction areas.
 - 1. Tree valuation for trees species that do not have comparable and available replacement sizes shall be determined by a certified consulting arborist experienced in tree valuation using the "Guide for Establishing Values of Trees and Other Plants", current edition, published by the International Society of Arboriculture, Urbana, Illinois.
 - 2. Tree assessment shall include a physical description, health, condition and recommended pruning and/or mitigation measures based on the expected construction operations to minimize the negative impacts to the affected trees.

1.3 QUALITY ASSURANCE

- A. Tree Service Qualifications: An experienced tree service firm that has successfully completed tree protection and/or relocation work similar to that required for this Project, and who will provide experienced, certified tree workers.
- B. Arborist Qualifications: The arborist shall be certified by the International Society of Arboriculture. If the arborist is performing tree work, he/she shall be employed by a licensed contractor, or shall hold an individual license if independent.
- C. Tree Pruning Standards: Comply with ANSI A300, "Trees, Shrubs, and Other Woody Plant Maintenance--Standard Practices," unless more stringent requirements are indicated or recommended by the certified arborist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D 448, Size 24, with 90 to 100 percent passing a 2-1/2-inch sieve and not more than 10 percent passing a 3/4-inch sieve.
- B. Topsoil: See Section 32 93 00.
- C. Filter Fabric: Manufacturer's standard, nonwoven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers, minimum 4.8 oz/sq. yd.
- D. Temporary Fencing at the TPZ: Heavy-duty exterior rated plastic or chain link fencing, minimum four feet high with stakes at a maximum 10 feet on-center or as needed for a taut installation.
- E. Wood mulch: Walk-on type chipped wood and aged greenwaste material without leaves, green wood, sticks, dirt, dust, construction materials and other debris. Particle size 1/2" to 3" in general size.
- F. Coarse sand: Clean sand with greater than 95% passing a #10 sieve, less than 5% passing a #30 sieve, and less than 1% passing a #50 sieve.

2.2 TEMPORARY TPZ FENCING TYPES

- A. TPZ 1: Temporary fencing shall be installed at the drip line of the tree canopy. Where the canopy extends into remaining or proposed hardscaped areas, the posts may be supported by appropriate on-grade concrete or weighted bases.
- B. TPZ 2: Where existing trees are in planting strips with active walkways and/or roadways in the TPZ, the temporary fencing shall extend to the edge of the hardscaped areas to keep the walkways and/or roadways open.
- C. TPZ 3: Existing trees remaining in small planters or tree wells shall be wrapped with a minimum 2 inch thickness of orange plastic construction fencing from the ground to the first scaffold branch, or 4 feet high, whichever is greater. The wrapped section shall be covered with vertical 1.5 inch square slats and bound around the trunk firmly at least every 2 feet. Use caution when installing the slats so that the tree bark is not damaged.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Temporary Fencing: Install temporary fencing located around the canopy drip line of trees (the tree protection zone [TPZ]), and around the plants scheduled to remain that are inside the construction area. The TPZ fence layout shall be reviewed for acceptance by the Owners Representative and the consulting arborist.
- B. All work within the TPZ shall be reviewed and monitored by the consulting arborist.
- C. Within the TPZ, install a 4 inch depth of wood mulch over a permeable filter fabric with minimum 4 inch overlaps at fabric seams. Remove the protection mulch and fabric prior to any cultivation and amendment tillage.
- D. Provide a temporary dirt berm watering basin around trees and plants scheduled to remain. The berm around trees shall be a minimum diameter of six times (6x) the diameter of the tree at breast height (DBH), or not less than six feet in diameter, whichever is greater.
- E. Provide temporary irrigation or a portable water source to irrigate trees and plants scheduled to remain. Irrigate at minimum once a week or more often as necessary to moisten soil to a minimum 18 inch depth for trees, and a minimum depth of 12 inches for shrubs. Reapply irrigation based on an evapotranspiration loss of 50%.
- F. Protect plant/tree root systems within the protected fenced areas from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.
- G. Do not store construction materials, debris, or excavated material within the TPZ. Do not permit vehicles or reoccurring foot traffic within the TPZ to prevent soil compaction over root systems.
- H. Do not allow fires under or adjacent to remaining trees or other plants.

3.2 EXCAVATION

- A. Do not excavate within the canopy drip line of existing trees unless otherwise authorized. Any excavation within the TPZ shall be performed under the onsite monitoring by the consulting arborist.
- B. Where excavation for new construction and/or utility lines are required within the canopy drip line of trees, hand clear and excavate to minimize damage to root systems. Use spading forks to comb soil or use an Air-Spade to expose roots.
- C. Where utility lines are to be located within the drip line of trees, expose the existing root system to the depth of utility line installation plus the depth of any required bedding material. Place piping below and/or through the exposed roots without damage to the root system. Backfill with approved material and compact by flooding the area if allowed.
- D. As an alternative to manual or Air-Spade trench excavation, utility or other below grade piping may be mechanically bored under the crown dripline with a minimum cover of 3 feet as authorized by the consulting arborist.
- E. Root Pruning: Do not cut main lateral roots or taproots greater than one inch in diameter. Smaller roots less than one inch in diameter that interferes with the installation of new improvements and/or utility lines may be cut only if absolutely necessary. Only cut roots with sharp pruning instruments; do not break, tear or chop. Block out concrete footings

around roots greater than one inch diameter leaving a minimum one inch clearance around roots to remain. Provide alternative footing design if main lateral roots are in conflict.

3.3 REGRADING

- A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by the certified arborist, unless otherwise indicated.
 - 1. Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots or taproots; cut only smaller roots less than one inch diameter. Cut roots with sharp pruning instruments; do not break or chop.
- B. Minor Fill: Where existing grade is 12 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations. Do not place fill greater than 6 inches in depth within 24 inches of the trunk, and do not cover the trunk/root base flare. Do not allow standing water at the trunk.
- C. Moderate Fill: Where existing grade is more than 12 inches , but less than 18 inches below elevation of finish grade, place drainage fill, filter fabric, and topsoil on existing grade as follows:
 - 1. Carefully place drainage fill against tree trunk approximately 2 inches above elevation of existing grade and extend not less than 20 inches from tree trunk on all sides up to the finish grade. Slope of the rock fill shall be a maximum 2h:1v. For balance of area within drip-line perimeter, place drainage fill a minimum 6 inches in depth.
 - 2. Place filter fabric over the drainage fill with edges overlapping 6 inches minimum.
 - 3. Place fill layer of topsoil to finish grade. Do not mechanically compact drainage fill or topsoil more than 85% relative density in planted areas. Hand grade to required finish elevations.

3.4 TREE PRUNING

- A. Prune remaining trees affected by temporary and new construction only when authorized by the Landscape Architect and as recommended by the consulting arborist.
- B. Prune remaining trees to compensate for root loss caused by damaging or cutting root system only when authorized by the Landscape Architect and as recommended by the consulting arborist. Provide subsequent maintenance during Contract period as recommended by the consulting arborist.
- C. Pruning Standards: Prune trees according to ANSI A300 based on pruning for access clearance, to correct any defects in structure, or to remove potential conflicts with new improvements. Pruning shall only be performed by a Certified arborist or tree worker.
- D. Cut branches with sharp pruning instruments; do not break or chop. Clean pruning tools with a diluted bleach solution prior to performing any pruning operations.

3.5 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to written instructions of the arborist.

- B. Remove and replace dead and/or damaged trees impacted by the construction operations that the arborist determines to be incapable of restoring to a normal growth pattern.
 - 1. Provide new trees of the same size and species as those being replaced; plant and maintain as specified in 32 90 00.
 - 2. When new trees of the same size and species are not available, furnish and install the largest size boxed tree that is readily available and will successfully grow in the planting area with long term health and without damage to adjacent improvements. Credit the Owner the difference between the valuation of the removed existing tree and the installed replacement tree.
- C. Aerate surface soil within any existing Oak tree dripline compacted before or during construction, 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 18 inches deep at 36 inches o.c. Backfill holes with coarse sand. Manually till the top 4 inches with a spading fork, and break up clods greater than 1 inch diameter. Smooth grade prior to installing wood mulch.

3.6 CLEAN-UP

- A. Burning is not permitted.
- B. Prior to Final Acceptance, remove the TPZ fence, stakes and other related materials.
- C. Legally remove excess excavated material, debris, displaced trees, and greenwaste from Owner's property. Broom clean all hardscape surfaces in the area of work.

END OF SECTION

SECTION 321126
AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Provide all material, labor, equipment and services necessary to install aggregate base surfacing as indicated by the Contract Documents.
- B. RELATED SECTIONS
 - 1. Contract General Conditions and Division 1, General Requirements.
 - 2. Section 312000 – Earthwork: Excavation, Filling, and Grading.
 - 3. Section 312333 – Trench Excavation and Backfill.
 - 4. Section 321313 – Site Concrete Improvements.

1.3 REFERENCES

- A. SSFCDOT - Standard Specifications, Department of Transportation, State of California (Caltrans), latest edition, except for references to method of payment, and references to any state furnished materials

1.4 QUALITY ASSURANCE

- A. Provide and install in accordance with SSFCDOT.

1.5 SUBMITTALS

- A. Submit data sheets from supplier to document compliance with SSFCDOT requirements.
- B. Certificates of compliance for material.
- C. Load tags for delivered material.

1.6 COORDINATION

- A. Coordinate with other work, including subgrade preparation and soil sterilization.
- B. Coordinate installation schedule with Owner's use of the premises and with other contractors working at the site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aggregate Base: Unless specified otherwise on Plans, Class 2, 3/4 Inch Maximum per Section 26 of SSCDOT.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify quantities required.
- B. Verify that subgrade has been placed and compacted per Contract Documents
- C. Verify gradients and elevations of subgrade are correct.

3.2 INSTALLATION OF AGGREGATE BASE COURSE

- A. Install in conformance with SSCDOT Section 26, Aggregate Bases.
- B. Thickness - As shown on construction drawings.
- C. Spreading and Compacting - In accordance with Section 26, SSCDOT. Base course shall be moisture conditioned to within 2% of optimum moisture, placed in uncompacted layers not exceeding six (6) inches in thickness, and compacted as specified, based on ASTM Test Method D1557. The relative compaction of each layer of compacted base material shall be not less than 95 percent.
- D. The completed surface shall be thoroughly compacted, free from ruts, depressions, and irregularities, true to grade and cross-section.
- E. Lines and grades for the installation of aggregate base shall be set by a California licensed Land Surveyor or Civil Engineer, at Contractor's expense.

3.3 TOLERANCES

- A. Compacted thickness of aggregate base: Not less than the thickness specified on the Plans.
- B. Finished Surface: Within 0.02 foot of planned grade per Section 26, SSCDOT. No more than 50% of the finish surface shall be above or below the specified grade for aggregate base.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by the Owner's inspector, under provisions of Division 01.

3.5 PROTECTION

- A. Immediately after placement and compaction, protect surface from mechanical injury.
- B. Protect completed surface until surfacing layers are in place.

END OF SECTION

SECTION 321313
SITE CONCRETE IMPROVEMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. All material, labor, equipment and services necessary to completely install exterior Portland cement flatwork, cast-in-place concrete, and architectural flatwork concrete, accessories and other related items, slabs, ramps and sidewalks and walkways, curb and gutter, mowstrips, and other miscellaneous concrete items of the form and dimensions shown on the plans and necessary to complete the project, and in accordance with the requirements of the Standard Specifications as modified and supplemented by these Special Provisions
- B. RELATED SECTIONS:
 - 1. Contract General Conditions and Division 1, General Requirements.
 - 2. Section 312000 - Earthwork: Excavation, Filling, and Grading
 - 3. Section 321126 - Aggregate Base Course
 - 4. Section 321315 - Concrete Reinforcement

1.3 REFERENCES

- A. SSCDOT - Standard Specifications, Department of Transportation, State of California (Caltrans), latest edition, except for references to method of payment, and references to any state furnished materials.
- B. ACI standards, including but not limited to #304, 305, 306, 308, 309 and 347.
- C. ASTM standards, including but not limited to #C-33, C-39, C-94, C-136, C-143, C-150, and C-309.

1.4 SUBMITTALS

- A. Submit under provisions of Specification Section SUBMITTALS.
 - 1. Certificates of compliance for materials and mix designs.
 - 2. Load tags for delivered material.
 - 3. Strength testing as required by the approving agency.

4. Integral color sample, where applicable.
5. Application instructions for the architectural finish materials.
6. Accessories and manufacturer's installation specifications.

1.5 QUALITY ASSURANCE

- A. Furnish concrete materials conforming with SSCDOT.
- B. Perform work in accordance with SSCDOT, unless noted otherwise herein.

PART 2 - PRODUCTS

2.1 MIXES

- A. Mix Design and Proportions in accordance with SSCDOT:
 1. Mix designs with Fly Ash content no greater than 15 percent of the total weight of cementitious materials shall be proportioned by SSCDOT.
 2. Provide a maximum of 4 percent air entrainment, unless noted otherwise.
 3. Owners Testing laboratory shall review all mix designs before submittal.
 4. All concrete shall have the following minimum compressive strengths in accordance with ACI 318 and SSCDOT at 28 days and shall be proportioned within the following limits:
 - a. Site Concrete: Use for exterior concrete slabs on grade including, but not limited to sidewalks, curbs, gutters, mow strips, utility appurtenances and miscellaneous site improvements.

1) Strength:	3,000 psi at 28 days
2) Maximum Aggregate Size:	1-inch
3) Cement Type:	Type II
4) Cement Content:	5.5 sacks/yd minimum
5) Max Water/Cement Ratio:	Per SSCDOT
6) Admixture	Per SSCDOT
 - b. Structures & Vehicular Concrete Paving: Use for site structures and exterior slabs on grade subject to vehicle traffic.

1) Strength:	4,000 psi at 28 days
2) Maximum Aggregate Size:	1-inch
3) Cement Type:	Type II
4) Cement Content:	6.5 sacks/yd minimum
5) Max Water/Cement Ratio:	Per SSCDOT
6) Admixture:	Per SSCDOT
 - c. Slurry Backfill: Use for backfill of over-excavated trenches, encasement of all penetration, and site utility piping.

1) Maximum Aggregate Size:	3/8-inch
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- | | | |
|----|-----------------|----------------------|
| 2) | Cement Type: | Type II |
| 3) | Cement Content: | 2.0 sacks/yd minimum |

- B. Reinforcement shall comply with relevant portions of Division 32 Specification Section CONCRETE REINFORCEMENT.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade shall conform to the requirements of Division 31 Specification Section EARTHWORK: EXCAVATION, FILLING AND GRADING. The District may elect to verify compacted subgrade elevations by measurement made from adjacent existing improvements or by a template supported by forms.

3.2 GENERAL CONCRETE

- A. Concrete placement shall conform to the applicable requirements of Standard Specification Sections 51 and 90. Concrete shall not be placed when the air temperature in the shade at the project site exceeds 95° F or is below 45° F, or when the temperature of the concrete exceeds 85° F.
- B. After the concrete has been placed, it shall be struck off to proper section and compacted with a grid of parallel metal bars until a layer of mortar not less than 3/8 inch thick has been brought to the surface. All exposed concrete surfaces shall receive a medium broom finish applied transversely to the line of pedestrian traffic or to the longest dimension of the concrete, as applicable.
- C. General concrete surfaces shall be cured by the curing compound method and shall be protected in accordance with the provisions of Subsections 90-1 and 90-2 of the Standard Specifications.

3.3 PROTECTION OF CONCRETE

- A. The Contractor shall be responsible for the condition of all concrete work until such time as all work has been completed and is accepted by the District. The Contractor shall limit vehicular travel across concrete until such time as the concrete has achieved strength sufficient that it can support traffic without damage. In no case, however, will vehicles be allowed to travel across new concrete improvements until seven calendar days have passed since the concrete was placed.

3.4 CONCRETE JOINTS

- A. Expansion joints and weakened plane joints shall be constructed at the locations shown on the plans or as directed by the Engineer. Where joint locations are not spec

ified on the plans, expansion joints shall be constructed at maximum intervals of 30 feet, and weakened plane joints shall be constructed at maximum intervals of 15 feet.

- B. Expansion joints shall be considered as weakened plane joints for the purpose of spacing weakened plane joints. Expansion joints shall be tooled with a 1/4 inch maximum radius edger, and shall be filled with 3/8 inch pre-formed expansion joint filler.

3.5 CONCRETE FINISHES

- A. Where concrete is being installed adjacent to or near existing concrete improvements, match the finish of similar concrete surfaces (i.e. new sidewalks shall match existing sidewalks, new curbs shall match existing curbs, etc.).
- B. Sidewalks and Mowstrips: Medium sweat finish or medium broom finish perpendicular to the direction of travel.
- C. Curbs: Trowel smooth and finish with a light brush.
- D. Gutters: Medium broom finish parallel with curb or direction of flow.
- E. Drive approaches and wheelchair ramps: medium broom finish, perpendicular to the direction of travel.

3.6 INSTALLATION OF ACCESSORIES

- A. Strictly comply with manufacturer's instructions and recommendations and approved details. Securely anchor work to substrate.

3.7 REPAIR AND CLEAN-UP

- A. Contractor shall legally remove all trash, debris, containers and excess materials from the site on a periodic basis, and shall keep the work broom clean until Owner's acceptance.
- B. The Contractor shall be held responsible for the repair and/or replacement of new or existing improvements damaged as a result of this work to the satisfaction of the Owner.
- C. The Contractor shall provide roll-off bins for wash-out of ready mix concrete trucks and pumpers. Do not allow concrete debris or cement water onto soils scheduled for landscape planting.

END OF SECTION

SECTION 321315
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. Deformed reinforcing bars for site concrete improvements.
- B. RELATED SECTIONS
 - 1. Contract General Conditions and Division 1, General Requirements.
 - 2. Section 321313 - Site Concrete Improvements.

1.3 SUBMITTALS

- A. Submit in accordance with Specification Section SUBMITTALS and the Contract General Conditions.
 - 1. Mill test certificates identifying chemical and physical analysis of each load of reinforcing steel delivered. If mill test reports are not available and the quantity of steel for a structure exceeds 5 tons, provide a laboratory test to prove yield strength and bending.
 - 2. Drawings and placing diagrams for each grade slab including dowels and corner bars.
 - 3. On the placing diagrams, show all openings for pipelines and architectural features. Include additional reinforcing at openings and corner bar arrangements at intersecting beams, walls, and footings.
 - 4. Coordinate placing diagrams with the concrete placing schedule.

1.4 PRODUCT DELIVERY

- A. Deliver reinforcement to project site in bundles marked with tags indicating bar size and length.
- B. Store on wooden supports above ground surface.

PART 2 - PRODUCTS

2.1 BARS

- A. Bars shall be deformed billet steel conforming to ASTM A 615, Grade 60. Mixing of steel grades will not be allowed.

2.2 BAR SUPPORTS

- A. Bar support shall be concrete or metal chairs, spacers or hangers. Reinforcing bars shall not be supported by forms.

2.3 TIE WIRE

- A. Tie wire shall be annealed steel wire of not less than 16-gauge.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Position reinforcement in accordance with the drawings, secure with wire ties or suitable clips at all intersections, and support by an adequate number of concrete or metal chairs, spacers, or metal hangers such that reinforcing bars do not sag more than one quarter of an inch (1/4") between supports. Do not place reinforcement or supports in contact with the forms. Bend tie wires away from the forms in order to provide the specified concrete coverage. To secure reinforcement in position, the Contractor may elect to locate bars additional to those shown on the drawings, but at no additional cost to the Owner.
- B. Set reinforcing dowels and anchor bolts in place prior to placing concrete. Do not press them into the concrete after the concrete has been placed.

3.2 SPLICES

- A. Splice bars only at locations shown on the drawings. Where splices are not detailed, lap bars 72 bar diameters.

3.3 CLEANING

- A. Remove dirt, form oil, excessive rust, cement coating from previous pours, and foreign matter that will reduce bond with concrete.

3.4 PROTECTION DURING CONCRETING

- A. Keep reinforcing steel in proper position during concrete placement.

END OF SECTION

SECTION 323113
CHAIN LINK FENCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Provisions of constructing chain link fence at locations shown on the Construction Documents, including but not limited to:
 - a. Site chain link fencing and gates.

B. RELATED SECTIONS

1. Contract General Conditions and Division 1 Specifications.
2. Section 312000 – Earthwork: Excavation, Filling, and Grading
3. Section 321313 – Site Concrete Improvements.

1.2 QUALITY ASSURANCE

A. Qualifications of Installer

1. Throughout the progress of installation of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this Section.
2. In actual installation of the work of this Section, use adequate numbers of skilled workmen to insure installation in strict accordance with the contract documents.
3. In acceptance or rejection of work performed under this Section, the Engineer will make no allowance for lack of skill on the part of the workmen.

1.3 PRODUCT HANDLING

A. Protection

1. Use all means necessary to protect the materials of this Section before, during and after installation, and to protect the work of other trades.

B. Replacements

1. In the event of damage, immediately make all repairs and replacements necessary to the satisfaction of the Engineer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The materials and fabrication of chain link fabric shall conform to these specifications, and as shown on the plans and details.
- B. All ferrous materials shall be new and galvanized. Imperfectly galvanized material or material upon which serious abrasions of the galvanizing occur shall not be used.
- C. Height - all fencing shall stand at the heights shown on the plans.
- D. Fabric
 - 1. Standard: Chain link fabric shall conform to ASTM, designation: A392, Class 1. The wire used in the manufacture of the fabric shall be 9-gauge. All chain link fabric shall be woven into approximately 2-inch mesh. Fabric shall be furnished with knuckling at all selvages. The knuckled selva shall be used along all corners and edges. Fabric shall be GBW, galvanized before weaving.
 - 2. Pool Perimeter: Chain link fabric shall conform to ASTM, designation: A392, Class 1. The wire used in the manufacture of the fabric shall be 9-gauge. All chain link fabric shall be woven into approximately 1-inch mesh unless otherwise stated on plans. Fabric shall be furnished with knuckling at all selvages. The knuckled selva shall be used along all corners and edges. Fabric shall be GBW, galvanized before weaving.
 - a. 80% Blockage Privacy Screen: For chain link fence specified as having a 80% blockage privacy screen, the privacy screen shall be 8' FenceScreen Commercial PVC Mesh 300 Series Fence Privacy Windscreen Fabric with a screen center-binding strip or approved equal. The fabric shall be installed per the manufacturer's recommendations. The color shall be selected by the Owner.
 - b. 90% Blockage Privacy Screen: For chain link fence specified as having a 90% blockage privacy screen, the privacy screen shall be 8' FenceScreen Privacy Fence Screen PLUS 200 Series Fence Privacy Windscreen Fabric with a screen center-binding strip or approved equal. The fabric shall be installed per the manufacturer's recommendations. The color shall be selected by the Owner.
- E. Posts, braces and gate frames
 - 1. The base material for the manufacture of steel pipe used for posts and braces shall conform to the specifications of ASTM, designation: A53 Type A, standard weight, Schedule 40, and the base material for the manufacture of other steel sections used for posts and braces shall be good commercial quality weldable steel.
 - 2. All posts, braces and gate frames shall conform to the size and weight designations shown on the plans.
 - 3. All posts shall be fitted with rainproof caps designed so as to fit securely over the top of the posts.
 - 4. All posts shall be of a total length of not less than the depth of the concrete footing as shown on the plans, plus the length required above ground.

5. Posts and braces shall be galvanized in accordance with specifications of ASTM, designation: A123.
 6. All horizontal braces shall be attached to posts by approved steel fixtures.
- F. Stretcher bars and other required fittings and hardware shall be steel and shall be galvanized in accordance with the specifications of ASTM, designation: A153.
- G. All swinging gates and walk gates shall be installed with a gate holdback, Trimco 1209HOHA-626. Holdbacks shall be installed in the concrete mowstrip, unless otherwise noted.
- H. Concrete mowstrip shall be in accordance with Section 321313 SITE CONCRETE IMPROVEMENTS.
- I. Walk gates shall be constructed as per detail drawing and in accordance with CBC sections 11B-206.5 and 11B-404.
- J. Drive gate, roll gate and walk gate shall be constructed as per detail drawing.
- K. Non-accessible swinging gates shall comply with the following:
1. Have a lockable fork latch.
 2. Have heavy-duty malleable iron hinges

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All posts shall be set in concrete footings as shown on the plans to within 3 inches of bottom.
- B. All vertical line and end posts shall be braced to the nearest adjacent vertical post with galvanized horizontal braces as shown on the plans.
- C. Welding
1. All welding shall conform to the requirements of the California Building Code, CBC, Chapter 22.
 2. Where the galvanized surface has been burned by welding, all surfaces of the welded connections shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked galvanizing removed. The damaged area and weld shall then be painted in accordance with the following details.
 - a. All galvanized, welded, or damaged surfaces that are to be painted shall first be cleaned by washing with mineral spirit solvent sufficient to remove any oil, grease or other materials foreign to the galvanized coating.
 - b. After washing, all areas shall be roughened by abrasive blasting using an abrasive that is no larger than 30-mesh. Galvanizing shall not be removed by this operation.
 - c. After preparation, all galvanized surfaces that are to be painted shall be covered with one application of zinc dust-zinc oxide primer, federal specification TT-P-641, Type II. The zinc dust-zinc oxide paint shall be

applied by spraying to produce a complete covering of the galvanized surface.

- d. After the application of the zinc dust-zinc oxide paint, one application of pre-treatment, vinyl wash primer, Section 91-2.7 of the state Standard Specifications, shall be applied to such surfaces. The vinyl wash primer shall be applied by spraying to produce a uniform wet film on the surface.
 - e. Such surfaces shall then be covered with two separate applications of white tint base vinyl finish coat, Section 91-2.22 of the state standard specifications, sufficient to completely cover the preceding color. Paint for the first application shall be tinted with a compatible coloring agent to slightly contrast with the color of the second application. After drying for 24 hours, one application of aluminum paint, finish coat, Section 91-2.8 of the state standard specifications, shall be painted on the welded areas.
- D. Perimeter fencing chain link fabric shall be fastened to the outside of the fence.
- E. All fabric shall be stretched and securely fastened to the posts, as follows:
- F. The fabric shall be fastened to end, corner and gate posts with 3/16 inch by 5/8 inch stretcher bars and not less than 1/8 inch by 3/4 inch stretcher bar bands spaced at one foot intervals for whatever widths of fabric are supplied. The fabric shall be fastened to line posts with tie wires or post clips. Tie wires shall be at least 9-gauge (0.148 inch diameter) steel. Post clips shall be at least 6-gauge (0.192 inch diameter) steel. The wire or clip fasteners shall be spaced at approximately 14 inches on line posts, with a minimum of 5 fasteners per 6 foot high post. Top and bottom edges of the fabric shall be secured to each horizontal brace with tie wires or fastened to tension wire with hog rings spaced at 15 inch maximum intervals. Hog rings shall be at least 9-gauge (0.148 inch diameter) steel. Wire ties shall be given at least one complete turn. Hog rings shall be closed with ends overlapping. The distance from the selvage to the braces or top rails shall be 2 inch maximum and shall be fastened to the brace or rail by wire fasteners spaced at approximately 14 inches with a minimum of 8 fasteners per each 10 foot horizontal span.
- G. Construct concrete mowstrip at the width as shown on the plans.

END OF SECTION

SECTION 323119
DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. Decorative metal fences and gates (shop fabricated)
- B. Related Requirements:
 - 1. Division 03 Section "Cast-in-Place Concrete" for concrete setting fence posts.
 - 2. Division 05 Section "Metal Fabrications" for metal fabrications not included in this section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Include plans, elevations, component details, and attachments to other work. Indicate materials and profiles of each metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal fencing and gates similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: Fabricator of products.
- C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code – Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code – Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal fencing and gates in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal fencing and gates by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements for Gates and Hardware: Pedestrian gates and hardware indicated to be accessible shall comply with accessibility requirements of the latest ADA Standards for Accessible Design and the latest California Building Code, Chapters 10 and 11B.
 - 1. Gates shall be capable of opening a minimum of 90 degrees.
 - 2. Gates in the open position shall provide a clear opening width of not less than 32 inches.
 - 3. The bottom 10 inches of the push side gates shall have a smooth uninterrupted surface that allows the door to be opened by a wheel chair footrest without creating a trap or hazardous condition.
 - 4. The effort to open gate shall not exceed a 5 pound force applied perpendicular to the face of the gate.
 - 5. Gates shall be openable from the secure side (inside) without the use of a key or special knowledge or effort. Operating hardware shall not require pinching or grasping to operate hardware.
 - a. Gates may be designed for key operation from either or both sides when the gates are not required egress gates as determined by the Architect and the Division of the State Architect.

2.2 STEEL AND IRON MATERIALS

- A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Tubing: ASTM A 500/A 500M (cold formed).

- C. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M unless otherwise indicated.
- F. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel or structural steel, exposed.

2.3 FASTENERS

- A. Fastener Materials: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating or Type 304 stainless steel.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Post-Installed Anchors: Mechanical fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
 - 1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.5 SETTING MATERIALS

- A. Cementitious Material: Portland cement, ASTM C 150, Type II, gray.
- B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information. Proportion normal-weight concrete mixture as indicated below for strength, slump, water/cement ration, and maximum aggregate size.
 - 1. Strength: 3000psi at 28 days.
 - 2. Aggregate Size: 1-1/2 inch maximum.
 - 3. Slump: 4 inches.
 - 4. Water Cement Ration: 0.53 Maximum.

2.6 FABRICATION. GENERAL

- A. Fabricate fence panels in sections to prevent the need for field welding or cutting. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
 - 1. Components of fabricated items shall not be finished until after fabrication.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- D. Provide necessary brackets to assemble units and to attach other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
- E. Connect members with full-penetrations welds unless otherwise indicated. Use welding method that is appropriate for metal and finish indicated and that develops full strength of members joined. Finish exposed welds and surfaces smooth, flush, and blended to match adjoining surfaces.

2.7 DECORATIVE METAL FENCING

- A. General: Fabricate decorative metal fencing from steel bars and shaped of sizes and profiles indicated.
 - 1. Fabricate fence panels in sections to facilitate galvanizing, transportations to the Project Site, and installation.
- B. Fence Height: As indicated on Drawings.
- C. Posts, Rails, and Pickets: Square steel tube sections complying with ASTM A-500 with hot dipped galvanized exterior zinc coating and as follows:
 - 1. Posts: Posts having a minimum yield strength of 45,000 psi and a minimum size as follows:
 - a. Posts for Fences: 4 inches square x 1/8 inch thickness.
 - 1) Spacing: Nominal 8 feet on center maximum; posts shall be equally spaced on a standard module.
 - b. Posts for Swing Gates: Size as follows:
 - 1) Gates to 48 inches Wide: 4 inches square x 1/8 inch wall thickness.
 - 2) Gates over 48 inches Wide to 96 inches Wide: 6 inches square x 1/4 inch thickness.
 - 3) Gates over 96 inches wide to 144 inches Wide: 6 inches square x 3/8 inch thickness.
 - 2. Horizontal Rails: 2 inches square x 11 gage (0.120 inch).

- 3. Pickets: 1 inch square x 14 gage (0.080 inch).
 - a. Spacing: Nominal 6 inches on center nominal.
- D. Finish: Galvanize and powder coat after fabrication.

2.8 SWING GATES

- A. General: Fabricate decorative metal swings from steel bars and shapes of sizes and profiles indicated in Drawings, match characteristics of fence design.
- B. Gate Height: Match adjacent fence panels.
- C. Gate Width: As indicated on Drawings; 32 inches minimum clear width when gate is in a 90 degree open position.
- D. Gate Framing: Hollow tubular steel sections of size, wall thickness, and spacing as indicated on Drawings, not less than 2 inches x 2 inches x 11 gauge (0.120) minimum size).
- E. Rails: Match fence rails.
- F. Pickets: Match fence pickets.
- G. Hinges: Butt hinges or pivots as selected by fabricator; hinges to be sized for not less than twice the weights of the gate and allow the gate to open 180 degrees.
- H. Operating Hardware: Gates shall be prepared to receive a cylinder lock, mortise lock, or exit device as indicated on the drawings.
- I. Finish: Galvanize and powder coat after fabrication

2.9 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plate, bars, and strips indicated to be galvanized to comply with ASTM A 123/A 123M. Galvanize items after fabrication.
 - 1. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A 153/A 153M.
 - 2. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filling of smooth.
- B. Powder-Coat Finish for Galvanized Metal: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
 - 1. Prepare galvanized metal be thoroughly removing grease, dirt, oil, flux, and other foreign matter.
 - 2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
 - 3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 2 mils.

4. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal fences and gates
- B. Proceed with installations only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide anchorage devices and fasteners where needed to secure decorative metal fencing to in-place construction.
- B. Set posts accurately in location alignment, and elevation; measured from established lines and levels.
 1. Post Excavation: Drill or hand-excavate holed for posts to diameters and spacings indicated, in firm, undisturbed soil. Footings shall have a diameter not less than 4 times the width of posts and shall extend 6 inches below the bottoms of the post.
 2. Post Setting: Set posts in concrete into firm, undisturbed soil. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices. Crown top of exposed concrete to drain water away from posts. Protect aboveground portion of posts from concrete splatter.
- C. Install gate level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.
- D. Perform cutting, drilling, and fitting required to install decorative metal fencing. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- F. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations by complete refinishing, or provide new units as required.

- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication. General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- H. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 ADJUSTING

- A. Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortions, nonalignment, misplacement, disruptions, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.4 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint exposed areas with same materials as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/ A 780M.
- D. Protect finishes from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- E. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 328400
IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Provide all materials, labor, equipment and services necessary to furnish, install and maintain the Irrigation System, accessories and other related items necessary to complete the Project as indicated by the Contract Documents unless specifically excluded.
- B. Related Work Specified Elsewhere
 - 1. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 1 Specification Sections, apply to work of this section.
 - 2. Section 31 20 00 – Earthwork
 - 3. Section 31 23 00 – Trench Excavation and Backfilling
 - 4. Section 32 90 00 – Landscape Planting

1.2 CODES AND REGULATIONS

- A. All work and materials shall be in full accordance with the following codes adopted and amended by the authority having jurisdiction. Nothing in these drawings or specifications is to be construed to permit work not conforming to these codes. The work described in these specifications shall govern in the event that the drawings or specifications call for material or methods of construction of higher quality or standard than required by these codes.
 - 1. California Plumbing Code
 - 2. California Administrative Codes:
 - a. Title 8, Industrial Relations
 - b. Title 19, Public Safety
 - 3. California Electrical Code
 - 4. California Green Building Standards Code, Section 5.304.
 - 5. California Department of Water Resources, Model Water Efficient Landscape Ordinance (MWELO)
 - 6. Standards and Regulations of other agencies, water utility provider, or organizations as listed in this specification relating to products or procedures, e.g. American Society for Testing and Materials.

1.3 DEFINITIONS

- A. Piping: All pipe fittings, valves, and accessories as required for a complete irrigation system.
- B. PVC: Polyvinyl Chloride.
- C. Agencies and Organizations:
 - 1. ASTM- American Society for Testing and Materials
 - 2. AWWA- American Water Works Association
 - 3. IAPMO- International Association of Plumbing and Mechanical Officials

4. CEC - California Electrical Code
 5. UL - Underwriter's Laboratories
 6. SSPWC – Standard Specifications for Public Works Construction, by the American Public Works Assoc./Associated General Contractors of California.
- D. Owner: An authorized representative of the Owner or the Owner's authorized consultant.

1.4 QUALITY ASSURANCE

- A. The work of this section shall be performed by a single firm experienced in irrigation work and holding a current California Contractor's A or C27 License.
- B. Qualifications of Workers
1. The Contractor shall employ skilled workers who are thoroughly trained and experienced in irrigation system installation and who are completely familiar with the specified requirements and methods needed for proper performance of this work.
 2. The Contractor shall provide adequate supervision by a qualified foreman fluent in English that will be continuously onsite during the performance of this work.

1.5 SUBMITTALS

- A. An operational assessment report of any existing irrigation system in the area of work shall be submitted prior to the start of the project's work, including demolition and clearing. See Subsection 1.07.
- B. The Contractor shall submit complete lists of proposed materials and equipment per the Division 01 Submittal Section, including manufacturer's name and model numbers. Only provide additional product data and/or catalog cut sheets if a substitute material or equipment is proposed. No substitution will be allowed without prior written approval.
- C. Shop drawings shall be provided for the layout and description of all equipment assemblies, including dimensions, capacities, and other characteristics as listed in product specifications. Shop drawings for booster pump assemblies shall clearly and neatly indicate the layout of the assemblies and proposed piping in the pump yard, and shall show adjacent equipment, required clearances, walls, fences, piping and other existing permanent improvements affecting the layout. Materials and equipment shall not be ordered until given written acceptance. Equipment or materials installed or furnished without prior approval or acceptance may be rejected and the Contractor shall be required to remove such materials from the site at his own expense.
- D. When specific name brands of equipment and materials are used, they are intended as preferred standards only. This does not imply any right upon the part of the Contractor to furnish other materials unless specifically approved in writing as equal in quality and performance by the Owner. Decisions by the Architect/Engineer shall govern as to what name brands of equipment and materials are equal to those specified on the plans and his decisions shall be final. It shall be the responsibility of the Contractor to furnish proof as to equality of any proposed equipment or material.

- E. Approval of any item, alternate or substitute indicates only that the products apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.
- F. Acceptance of any submittals, deliverables, or other work product of the Contractor shall not be construed as assent that the Contractor has complied with, nor in any way relieved the Contractor of compliance with (i) the applicable standard of care, and/or (ii) applicable statutes, regulations, rules, guidelines, and contract requirements.
- G. Irrigation Equipment: When the Contractor desires to transfer salvaged irrigation equipment and/or new spare equipment and/or parts to the Owner, he must submit along with the equipment an itemized list. The Contractor is solely responsible to obtain a written confirmation by the Owner that all materials received by the Owner matches his material list. The transfer of materials will not be considered executed without written confirmation of same.
- H. Submit any required or requested testing data and/or Certificates, including but not limited to the backflow prevention assembly testing Certificate after the assembly is installed prior to regular system operation.

1.6 EXPLANATION OF DRAWINGS

- A. The intent of the drawings and specifications is to indicate and specify a complete and efficient sprinkler irrigation system ready for use in accordance with the manufacturer's recommendations, and all applicable local codes and ordinances. Interpretation of irrigation plans and specifications shall be the responsibility of the Landscape Architect or Owner.
- B. All existing systems and improvements are shown in their approximate locations. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and shall report any variations to the Owner.
- C. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all his work, and plan his work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed in the most direct and workmanlike manner, so that conflicts between sprinkler systems, planting, utilities, and architectural features will be avoided. Locate pipe, valves and other equipment in planting areas unless specifically noted otherwise.
- D. All work called for on the drawings by notes shall be furnished and installed whether or not specifically mentioned in the specifications.

1.7 EXISTING CONDITIONS

- A. The Contractor shall not install the irrigation system and equipment as shown on the Drawings when it is obvious in the field that obstructions or differences in existing

conditions and/or systems are present. Such obstructions or differences should be immediately brought to the attention of the Owner. Failure to provide notification prior to the start of this work shall make the Contractor liable for any and all repairs and/or corrections necessary for proper functioning and coverage of the system without any additional cost to the Owner.

- B. The Contractor shall examine carefully the site of work contemplated and the proposal, plans, specifications, and all other contract documents. By submitting a bid, the Contractor attests that he has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and quantity of work to be performed and materials to be furnished, and the requirements of the specifications. The Contractor shall take necessary precautions to protect existing site conditions that are to remain. Should damage be incurred, the Contractor shall make the necessary repair or replacement to bring it back to its original condition at his own expense.
- C. Prior to cutting into the soil, the Contractor shall coordinate with the Owner to locate all cables, conduits, sewers, septic tanks, and other such underground utilities as are commonly encountered and he shall take proper precaution not to damage or disturb such improvements. If a conflict exists between such obstacles, notify the Owner who will consider realignment of the proposed work. The Contractor will proceed in the same manner if a rock layer or any other condition encountered underground makes change advisable. Should utilities not shown on the plans be found during excavations, Contractor shall promptly notify the Owner for instructions as to further action. Failure to do so will make Contractor liable for any and all damage thereto arising from his operations subsequent to discovery of such utilities not shown in plans.
- D. The Contractor shall verify the correctness of all finish grades within the work area in order to insure the proper soil coverage (as specified) of the sprinkler system pipes. The Contractor shall verify and be familiar with location and size of the proposed water supply (P.O.C.). He shall make approved type connection and install new work.
- E. The Contractor shall be responsible for notifying the Owner prior to installation that equipment or methods indicated on the drawings or in the specifications conflict with local codes, are incompatible or an error is apparent. If the event the Contractor neglects to do this, he will accept full responsibility for any revisions necessary.

1.8 PERMITS

- A. The Contractor shall obtain and pay required fees to any governmental or public agency. Any permits for the installation or construction of any of the work included under this contract, which are required by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examination required by these authorities.

1.9 TESTING

- A. General: Unless otherwise directed, tests shall be witnessed by the Owner. Work to be concealed shall not be covered until prescribed tests are made. Should any work be covered before such tests, the Contractor shall, at his expense, uncover, test and repair his work and that of other contractors to original conditions. Leaks and defects shown by tests shall be repaired and entire work re-tested. Tests may be made in sections, however, all connections between sections previously tested and new section must be included in the test.
- B. Main Line Piping: Hydrostatically test main line pipe segments after a minimum of twenty-four (24) hours after any solvent connections. Purge any free air in the test pipe sections. Partially backfill pipe but keep all joints exposed. Maintain 125 psi water pressure in new main line piping for a minimum duration of two (2) hours. There can be a maximum +/- 5psi change in pressure during the test.
- C. After being installed at the project site, any newly installed Backflow Prevention unit must be tested and approved as functioning properly per the local water agency requirements. Approval of the backflow prevention unit must precede any final inspection of the irrigation system. All costs for testing shall be the responsibility of the Contractor.

1.10 OBSERVATION

- A. General:
 - 1. Installation and operations must be approved by the Owner.
 - 2. In no event shall the Contractor cover up or otherwise remove from view any work under this contract without prior approval of the Owner. Any work covered prior to inspection shall be opened to view by the Contractor at his expense.
 - 3. In all cases, where inspection/observation of the irrigation system work is required and/or where portions of the work are specified to be performed under the direction and/or review of the Owner, including but not limited to the review items in the Irrigation plan Observation Log, the Contractor shall notify the Owner at least 72 hours in advance of the time when such review and/or direction is required. Any necessary re-excavation or alterations to the system needed because of failure of the Contractor to provide the required notification and/or to obtain the review/observation, shall be performed at the Contractor's own expense.
- B. Periodic observations shall be required for basic operations and installations during progression of the project. The Owner, or Project Inspector shall perform the observations and shall record the observation on the Irrigation System Observation Log form on the As Built Record Drawings. Such observations will include but not necessarily be limited to the following items as included in the scope of work:
 - 1. Layout and flagging of sprinkler heads.
 - 2. Trenching.
 - 3. Main line installation.
 - 4. Main line sustained pressure check.
 - 5. Wire placement.
 - 6. Partial fill compaction of trenches.
 - 7. Control valve installation.
 - 8. Drip line installation prior to backfilling.

9. Irrigation controller installation and operation.
10. Backflow Prevention Assembly installation.
11. Booster Pump installation or modification and start-up.
12. Sprinkler/emitter coverage prior to the start of planting operations.
13. Overall system operation and primary/secondary communication.

C. Coverage & Operations Review:

1. When the irrigation system is operational and prior to soil conditioning operations, the Contractor in the presence of the Owner shall perform a coverage test of the irrigation system. The Contractor shall furnish all materials and labor required to perform the coverage test and to correct any minor inadequacies of coverage disclosed. The Contractor shall inform the Owner and Owner of any deviation from the plan required due to wind, planting, soil, or site conditions that bear on proper coverage. If such notification of necessary corrections or additions to the irrigation system is not provided prior to or during the coverage test, the Contractor shall make all subsequent adjustments and corrections needed for proper coverage without any extra cost to the Owner.
2. Prior to the start of the maintenance period, the irrigation system shall be reviewed by the Owner for proper operations, and a review of and training on equipment and associated controls performed. Any corrections and/or adjustment shall be made as a condition for the start of the maintenance period and subsequent Final Acceptance.
3. Submit a Pump Start-up and Training Report after start-up. Include a copy in the O&M manual.

D. Final Acceptance: The work will be accepted in writing when the entire project improvements have been completed to the satisfaction of the Owner. In judging the work, no allowance for deviation from the original plans and specifications will be made unless already approved in writing at proper time. Should it become necessary for the Owner to occupy any portion of the work area before the contract is fully completed, such occupancy shall not constitute acceptance. The Contractor will not be responsible for any damage caused by the Owner's separate work forces.

1.11 REJECTION OF NON-CONFORMING MATERIAL OR WORK

- A. The Owner reserves the right to reject any material or work which does not conform to the contract documents. The rejected material or work shall be removed or corrected by the Contractor at no additional cost to the Owner.

1.12 OPERATIONS AND MAINTENANCE INSTRUCTIONS & RECORD DOCUMENTS

- A. The Contractor shall prepare and deliver to the Owner's Representative within ten (10) calendar days prior to completion of the maintenance period, all required and necessary descriptive material in complete detail and sufficient quantity, properly prepared in two individually bound sets of Operating and Maintenance Manuals. These manuals shall describe the material installed and shall be in sufficient depth to permit operating personnel to understand, operate and maintain all equipment. Spare part lists and related manufacturer identification shall be included for each installed equipment item. Each complete, bound manual shall contain the following information:

1. Cover sheet stating Contractor's address and telephone number, duration of guarantee period, and a list of equipment, with names and addresses of local manufacturer representatives and warranty periods.
 2. The Contractor to issue a "CERTIFICATE OF CONSTRUCTION COMPLIANCE" which indicates that all work done, materials and equipment used and installed are in compliance with the approved plans, specifications and all authorized revisions and that the system functions properly.
 3. Complete operating and maintenance instructions and warranties on all major equipment.
 4. Complete set of manufacturer's literature and specifications of material installed, including parts list.
 5. A list of the controller station number for each control valve if different than the control valve number shown on the drawings.
 6. Initial electrical data on each control valve:
 - a. Ohms reading for each valve taken at the controller (circuit is OFF).
 - b. Voltage reading for each valve taken both at the controller and at the valve (circuit is ON).
 7. A booster pump assembly start-up report by the pump assembly manufacturer's representative. The start-up report shall at minimum include:
 - a. A list of attendees to the start-up procedure and training session.
 - b. Record of pump parameters and settings.
 - c. Notes regarding any incomplete or non-compliant installation, equipment, communication or other work items related to the integration of the pump assembly into the overall irrigation system.
 - d. A schedule of recommended maintenance activities.
 - e. Customer service contact information for maintenance checks and warranty repairs.
- B. The contractor shall furnish one set of As-Built full-scale drawings on bond, and two compact disks with complete sets of digital PDF files of all close-out documents after the As-Built Record Drawings have been reviewed and accepted by the Landscape Architect.
1. Label first page of each document, or set of documents, "AS-BUILT PROJECT RECORD" in neat large printed letters on lower right hand corner. Record information concurrently with construction progress. Prints for this purpose may be obtained from the Owner. This set of drawings shall be kept on the site and shall be used only as a record set. Do not conceal any work until required information is recorded. These drawings shall also serve as work in progress sheets, and the Contractor shall make **neat and legible** annotations thereon daily as the work progresses, showing the work as actually installed. These drawings shall be available at all times for inspection and shall be kept in a location designated by the Owner.
 2. Drawings: Legibly mark to record actual construction:
 - a. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements. Give sufficient horizontal and vertical dimensions to accurately trace route and depth of each concealed line or item. Accurately locate each capped, plugged or stubbed line.
 - b. Field changes of dimension and detail.
 - c. Changes made by Field Order, Addenda, or other change document.

- d. Show the final controller station number for each control valve if different than the control valve number shown on the drawings.
- 3. Deliver all Close-out Documents (As-Built) to the Owner. Accompany submittal with transmittal letter in duplicate, containing:
 - a. Date.
 - b. Project title.
 - c. Contractor's name and address.
 - d. Title and number of each Record Document (As-Built).
 - e. Signature of Contractor or his authorized representative.
- C. The Contractor shall provide controller chart(s) as follows:
 - 1. The Contractor shall provide two controller charts for each controller's area of work.
 - 2. The chart shall show the area of work controlled by the automatic controller and shall be the maximum size that the controller door will allow.
 - 3. Show the controller station number for each control valve if different than the control valve number shown on the drawings.
 - 4. The chart may be a reduced drawing of the actual as-built system. However, in the event the valve numbering is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable when reduced.
 - 5. The chart shall be colored with a different permanent color for each station.
 - 6. The chart shall be enclosed in a waterproof envelope or laminated.
- D. Per MWELo Section 492.9, upon completion of the landscape planting and irrigation system, and as a condition of Final Acceptance and/or the issuance of a Certificate of Occupancy, the licensed landscape contractor shall submit to the approving agency and/or Owner, the following items in a form acceptable to the approving agency and/or Owner:
 - 1. Project information and contact information for the Owner and Applicant (Contractor).
 - 2. Certification that the installation complies with the approved Landscape Documentation Package.
 - 3. Irrigation scheduling parameters used in programming the controller during the establishment and maintenance periods.
 - 4. A Schedule of Irrigation System Maintenance.
 - 5. A Landscape Irrigation Audit Report per MWELo Section 492.12. Provide the Audit Report unless the report is not required by the approving agency or Owner.

1.13 SPARE PARTS AND EQUIPMENT

- A. Prior to the conclusion of the maintenance period, furnish the Owner with the following spare parts and equipment:
 - 1. One quick coupler key with attached hose swivel for each set of four quick coupler valves installed.
 - 2. Ten spare nozzles for each different sprinkler head arc and/or radius nozzle installed.
 - 3. One valve key for the 2" operating nut and/or hand wheel isolation valve.
 - 4. One hundred feet of in-line emitter tubing with ten straight and ten ninety degree compression fittings.

1.14 WORK AREA AND SAFETY

- A. The Contractor shall furnish, erect, and maintain all temporary facilities; perform all temporary work during the period of construction, including those herein specified. All facilities shall be maintained in proper and safe operating and sanitary conditions at all times.
- B. The Contractor shall comply with the provisions of the Construction Safety Orders, and General Safety Orders issued by the State Division of Industrial Safety, as well as all other applicable laws, ordinances and regulations.
- C. The project site shall be maintained in a neat and safe condition at all times. Cleanup shall be accomplished as the work progresses and upon completion of the work. The Contractor shall provide adequate safety measures to protect workers and the public from injury.

1.15 GUARANTEE

- A. Irrigation system consisting of materials, equipment and workmanship shall be guaranteed for proper operation a minimum of one year from date of Final Acceptance of the Work or the Notice of Substantial Completion of the Project, whichever is later. Manufacturer's warranty periods may be longer, and shall be noted in the close-out documents.
- B. The Contractor shall be held responsible for repair and/or replacement of damages to new or existing improvements resulting from the defects of materials, equipment or workmanship one year from the date of Final Acceptance of the Work or the Notice of Substantial Completion of the Project, whichever is later.
- C. The Owner reserves the right to make temporary repairs as necessary to keep the irrigation system equipment in operating condition. The exercise of this right by the Owner shall not relieve the Contractor of his responsibilities under the terms of the Guarantee as herein specified.
- D. The Booster Pump Assembly shall have a minimum 2 year warranty with no-cost annual service checks over the Warranty Period. See the Booster Pump Assembly and Controls sections for additional requirements.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Schedule rated white rigid PVC Pipe shall be made from NSF approved Type 1, Grade I, PVC compound conforming to ASTM D-1785.
- B. Class rated (Standard Dimension Ratio) white rigid PVC Pipe shall be made from NSF approved Type 1, Grade I, PVC compound conforming to ASTM D-1784.
- C. PVC pipe shall be of the Class or Schedule as follows:
 - 1. PVC pipe shall meet ASTM D-2241 for solvent weld, plain end, ASTM D-2672 for solvent weld, bell end, and ASTM D-3139 for gasketed bell end. Pipe shall be of the Schedule and/or Class as indicated herein.

2. Pipe sleeves under paving shall be PVC Schedule 40 for 3-inch and smaller or SDR 35 for 4-inch and larger pipes.
 3. Riser and/or manifold pipe connecting valves to main line fittings shall be Schedule 80 PVC.
 4. Pressurized main line pipe shall be Schedule 40, belled end with solvent welds for pipe sizes less than 2 inches. Pipe sized 2 inches and greater shall be Class 200, SDR 21, with gasketed bell ends.
 5. Non-pressurized lateral line pipe shall be Schedule 40, belled end with solvent welds.
- D. All pipes shall be continuously and permanently marked and conform with the following information: manufacturer's name or trademark, nominal pipe size, Schedule or Class of pipe, pressure rating in PSI, ASTM designation and (NSF) seal of approval.
- E. Rigid polyvinyl chloride (PVC) Fittings:
1. White Schedule 40 type I and II grade 1, solvent weld socket fittings ASTM D-2466 for all lateral lines 2-1/2 inches and smaller.
 2. Gray Schedule 80 type I and II grade 1 solvent weld socket fittings ASTM D-2464 for all main line less than 2 inches diameter, and lateral lines 3 inches and larger.
 3. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable (IPS) schedule, and (NSF) seal of approval.
 4. All plastic fittings and connectors shall be injection molded of an improved polyvinyl chloride compound featuring high tensile strength, high chemical resistance and high impact strength in terms of current ASTM standards for such fittings. Where threads are required in plastic fittings, these shall be injection molded also.
- F. PVC Solvent Weld Adhesive: All socket and bell type connections shall be joined with primer and PVC solvent cement which shall meet the requirements of ASTM F656 for primer and ASTM D2564, "Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings." Solvent cement joints for plastic pipe and fittings will be made as prescribed by manufacturer. The high chemical resistance of the pipe and fitting compounds specified in the foregoing sections makes it mandatory that an aggressive colored primer, which is a true solvent for PVC be used in conjunction with a solvent cement designed for the fit of pipe and fittings specified. A heavy bodied, medium set solvent cement, e.g. Weld-On 711 gray, shall be used for all classes and schedules of pipe and fittings.
- G. PVC Pipe Thread Sealant: A non-hardening all purpose sealant and lubricant similar to Permatex #51 or Lasco blue pipe thread sealant which is certified by the manufacturer to be harmless to PVC pipe and fittings. Apply sealant to clean male threads, brushing into grooves and to the first three threads of the female threads. A good quality grade of teflon tape recommended by the manufacturer for use with plastics may be used in lieu of sealant. Minimum width of tape to be used is 3/4". A minimum of two wraps and a maximum of three wraps shall be used.
- H. PVC Swing Joints: Connections to sprinkler heads from lateral lines shall be made with swing joints as detailed. Pre-assembled swing joints from Hunter, King Brothers or Spears are acceptable.
1. Use 6" length nipples for 1/2 inch inlet heads.

2. Use 12" length nipples for 3/4 or 1 inch inlet heads.
- I. Coated Ductile Iron pipe and fittings:
 1. Ductile Iron pipe shall be centrifugally cast pipe conforming to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, thickness Class 50, with cement - mortar lining and seal coating per ANSI/AWWA C104/A21.4.
 2. Ductile Iron flanged pipe shall conform to ANSI/AWWA C115/21.15.
 3. Ductile Iron flanged fitting to PVC pipe shall use a 'Megalug' mechanical joint restraint Series 2000PV by EBAA Iron per either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53, or equal.
 4. Joints shall comply with the following standards:
 - a. Rubber gasketed/mechanical joints: ANSI/AWWA C111/A21.11.
 - b. Flanged joints: ANSI/AWWA C110/A21.10, B16.1, B16.2.
 - J. Coated ductile iron push-on fittings meeting ANSI/AWWA C110 or C153/A21.10 shall be used for:
 1. Main line connections for pipe 3 inches and greater in diameter.
 2. New main line service tee at valve connections where a service saddle is not acceptable.
 3. Self-restrained fittings or joint restraints (Leemco LH or equal) shall be used for all elbows, tees, bends, etc fittings.
 - K. Coated ductile iron service saddles with stainless steel double straps, Smith-Blair 317, Romac Industries 202NS, or equal, shall be used for remote control/quick coupler valve service connections on main lines 1.25 inch or greater, and where the available outlet size can match the largest lateral line size downstream of the remote control valve.
 - L. Galvanized pipe and fittings:
 1. Galvanized Pipe shall be hot dip galvanized continuous welded, seamless steel SCH 40 pipe conforming to current ASTM A53 standards.
 2. Galvanized Fittings shall be galvanized, threaded malleable iron SCH 40 conforming to current ASTM A865 standards.

2.2 BACKFLOW PREVENTION ASSEMBLY

- A. The backflow prevention assembly is existing and shall remain in place.

2.3 VALVES

- A. Electric Control Valves:
 1. Globe valves operated by low-power solenoid, normally closed, manual flow adjustment. Sizes and types as shown on drawings.
 2. Provide a pressure regulating module on all control valves, or other pressure regulating components as part of the operating spray head or low volume head zones when the dynamic system pressure is, or may be greater than 45 psi.
- B. Electric Master Valves:
 1. The master valve is existing and shall remain in place.

- C. Control Valve Marking: Christy's valve identification tag (or equal), yellow color (purple color for recycled water) with text designating controller and valve station number, e.g. "A12", or equivalent.
- D. Isolation Valves:
 - 1. Cast bronze, coated ductile iron or coated cast iron gate valve with resilient wedge, non-rising stem and two inch operating nut for main line 2 inch size or greater. Match size of mainline.
 - 2. Cast bronze threaded gate valve with bronze cross handle for main line less than 2 inch size.
- E. Quick Coupling Valve: Two piece quick coupling valve as shown on the Drawings.

2.4 VALVE BOXES

- A. Control Valve/Master Valve/Flow Sensor boxes:
 - 1. Shrub/Ground Cover areas: Carson 1419 body with lockable tan plastic cover, or equivalent. Drip Valve Kits shall use a Jumbo body with lockable tan plastic cover.
 - 2. Turfgrass areas: Carson 1419 body with lockable green plastic cover, or equivalent.
 - 3. Hardscape areas: Christy B16 concrete box (11.75" x 22.25") with N16R composite solid flush lid, or equivalent.
- B. Quick Coupler Valve boxes:
 - 1. Shrub/Ground Cover areas: Carson 910 body with lockable tan plastic cover, or equivalent.
 - 2. Turfgrass area: Carson 910 body with lockable green plastic cover, or equivalent.
 - 3. Skinned ballfield areas: Christy F08 round concrete valve box (8" ID) with F08R concrete lid, or equivalent. Boxes in a sports venue's field of play that are noted to be installed below grade shall use a metal lid with a non-woven geotextile of a minimum 0.5 lb./sq. yd. covering the lid and box frame.
- C. Isolation Valve boxes:
 - 1. Gate Valve box in hardscape: Christy G05 round concrete valve box (10.375" ID) with cast iron G05C lid, or equivalent.
 - 2. Gate Valve box in planting areas: Christy F08 round concrete valve box (8" ID) with F08R concrete lid, or equivalent. Use F14 ADS adapter and extension for sizes 2.5 inches and larger.
 - 3. Ball Valve box: Same as 2.04, A.
- D. Control Valve box marking: Plastic lids shall have branded markings, and concrete lids shall have painted markings on the top of lid with minimum 2 inch high stenciled letters showing controller letter and station number.

2.5 CONTROLLER

- A. Solid state microcomputer controller, completely automatic in operation, which shall electrically start the sprinkler cycle and program and time the individual stations. Controller shall have attached instruction booklet, integral 24V transformer, clock

indicating time of day and day of week, 24V master valve circuit and terminal connection strip. See Drawings for manufacturer and model.

- B. Controller enclosure shall be of a size and type as specified on the Drawings.
- C. Upgrade components, sensors, flow meters and other accessories shall be a model type compatible with the controller and as specified on the Drawings. Controller assembly shall include boards and/or connections for sensor inputs. Weather sensors shall be located over a planting area.
- D. Grounding materials shall conform to ASIC Guideline 100-2002 and manufacturer's specifications.

2.6 CONTROL AND TRACER WIRE, COMMUNICATION CABLE

- A. Connections between the automatic controllers and the electric control valves, and tracer wire shall be made with direct burial AWG – UF 600 volt copper wire manufactured for irrigation system use.
- B. Hot control wires for the first controller shall be red. If multiple controllers are installed, the hot wire color shall be orange, yellow, purple in order for each controller. Common ground wire shall be white, with a color stripe corresponding to the hot control wire color when multiple controllers are installed. Spare control wires shall be black and spare common wire blue. Tracer wire shall be green.
- C. Install in accordance with valve manufacturer's specifications and wire chart. In no case shall wire size be less than #14. Common wire shall be a minimum #12 size.
- D. All control wire splices/caps shall be made with direct bury rated, waterproof wire connectors with silicone sealant, Spears DS-500 Dri-Splice, 3M DBR/DBY or approved equal. Use one splice per connector sealing pack.
- E. Apply waterproof numbered wire markers or sleeves at both sides of all splices and at the controller terminal board corresponding to the controller (A, B, etc.) and station number (02, 14, etc.). If multiple valves are connected to one station, add a single digit identifier (1, 2, etc.) to the station number (XX), e.g. A02-1, A02-2, etc.
- F. Communication/flow sensor cable shall be a shielded and jacketed, minimum 16 gauge twisted pair with drain wire, Paige P7162D or equal compliant with the controller manufacturer's specifications.
- G. Below-grade conduit for control wires and/or cables shall be PVC for electrical use with long radius sweeps at direction changes and at valve/splice/pull box terminations.

2.7 IRRIGATION HEADS

- A. Spray/Bubbler Pop-up Head: Molded plastic body with pop-up plastic riser and nozzle. Manufacturer's model numbers are listed with description on the Drawings.

- B. Rotor Pop-up Head: Molded plastic body with plastic riser and nozzle driven rotation with memory arc, balanced nozzle sets. Manufacturer's model numbers are listed with description on the Drawings.

2.8 BOOSTER PUMP ASSEMBLY AND CONTROLS

- A. Pump shall be a variable frequency drive (VFD) type and shall provide high efficiency and stable operating pressure (flat curve and low relative shut-off head should not exceed normal operation TDH by more than 30%) at the prescribed flows.
- B. Electrical power supply shall be 480 AC volts, 60Hz, triple phase. Provide an electrical service disconnect with fuses of appropriate amperage as part of the control panel.
- C. Welded or grooved steel or brazed/soldered copper tubing piping systems shall be provided. Threaded connections are allowed only at the interface of threaded mechanical appurtenances.
- D. All above-grade piping shall be sized to maintain velocities below seven-and-a-half feet (7.5') per second.
- E. Valves shall be 200 PSI rated, epoxy coated ductile iron resilient wedge gate valves, conforming to WWA C509 Standards.
- F. Bypass piping and valves shall be included in order to isolate the pump while providing non-boosted flow. Bypass check valve shall be flanged or wafer-style silent check valve in order to minimize water hammer during pump cycling.
- G. Inlet and discharge pressure gauges shall be two inches (2") stainless chased, glass faced, liquid filled and installed with gauge cocks (range to be minimum of 50% greater than normal operating pressure).
- H. The VFD pump control panel shall be UL certified. The panel shall have a manual disconnect switch. The controls shall have digital readouts with a color touch screen, minimum 320 x 240 pixel backlit operator interface, and be housed in a minimum NEMA 3R weatherproof enclosure. The unit shall have an across-the-line type magnetic starter and overload protection. Minimum control provisions shall incorporate programmable logic control (PLC) such as phase failure (low and high voltage) protection, time-delayed start, low supply low pressure and low/no flow safety control circuits. Control program shall enable variable pressure and/or flow set points for both pump activation and/or discharge pressure. The VFD unit shall be activated by user selection of either:
 - 1. The controller's pump start feature (station or program based) through the installation of a 24-volt AC pump start relay of sufficient amperage rating for the system, or
 - 2. A user defined line pressure drop through a pressure switch relay.
 - 3. A user defined flow rate through a flow switch relay.
- I. Integrate the VFD control panel into the pump assembly structure. Where the existing space available for access to the pump control panel is problematic, the

pump control panel may be surface mounted adjacent to the booster pump assembly where space and structure permits with the approval of the Owner.

- J. The pump assembly shall be an integrated unit on a steel support structure with a powder coated enclosure.
- K. Other features of the pump assembly shall include:
 - 1. A color touch screen for pump operation control options
 - 2. Pressure relief valve
 - 3. Air relief valve on high point of interior piping
 - 4. Exterior alarm light for flow or pressure loss alerts
 - 5. Pressure gauges on both intake and discharge piping.
 - 6. Offsite system monitoring, control adjustments and troubleshooting by means of a built-in cellular modem.
 - 7. A three year warranty for labor and parts from the start-up date.
 - 8. Three annual system operation reviews and status report to the Owner during the warranty period.
- L. Acceptable pump assembly vendors are:
 - 1. Precision Pumping Systems, Boise, ID. 208-323-5300; Rob Aldinger.
 - 2. Watertronics, WI, Western Regional Sales, 916-838-9459; Nunzio DiChristopher.
 - 3. Or approved equal in features, materials, warranty and maintenance service.

2.9 CONCRETE

- A. Cast-in-place Portland cement concrete used for pipe encasement, cover, thrust blocks, pipe support or other below-grade use shall at minimum comply with 2,800 psi 28 day strength.

2.10 OTHER MATERIALS

- A. Materials not specifically indicated but necessary for the proper execution of this work shall be of first quality as selected by the Contractor subject to the acceptance of the Owner.
- B. All materials appearing in the legend and details of the irrigation drawings are to be furnished and installed by the Contractor unless specifically noted to the contrary. Contractor is responsible for installation according to plans and details. The system shall efficiently and uniformly irrigate all areas and perform as required by these plans and specifications.
- C. Granular bedding material shall be clean natural occurring sand, free from clay, salt, sea shells or organic material, suitable for the purpose intended, and shall be of such size that 90 percent to 100 percent will pass a No. 4 sieve and not more than 5 percent will pass a No. 200 sieve.

PART 3 - EXECUTION

3.1 SYSTEM DESIGN AND VERIFICATION

- A. Contractor shall verify existing pressure and any existing irrigation equipment, and shall inform the Owner of any discrepancies between the existing systems' make and model of equipment, such as sprinkler heads, control valves, etc., and those indicated in the Drawings in writing prior to the start of irrigation system installation. Failure to inform the Owner of any discrepancy within seven working days prior to beginning of system installation will place the responsibility of any and all corrective action on the Contractor at no expense to the Owner.

3.2 PIPING INSTALLATION

A. General:

1. Any equipment installed by the Contractor and deemed to be for the use of the Owner in various situations (i.e., control valves, control panels, etc.) shall be so installed to be readily accessible and quickly operable. Equipment deemed by the Owner to be inoperable for its intended purpose shall be reinstalled by the Contractor in an operable position before approval will be given. Any changes made by the Contractor shall be done without any additional cost to the Owner.
2. The Contractor shall be responsible for layout of proposed facilities and any minor adjustments required due to differences between existing conditions and the Drawings. Any such deviations in layout shall be within the intent of the original drawings, and without additional costs to the Owner. The Owner will indicate the proposed precise location of the control panels. Head spacing on drawings is diagrammatic. Head spacing and patterns shall be adjusted to provide complete and adequate coverage with a minimum spray on non-planted areas. Where head spacing is not specifically noted, Contractor shall install sprinkler heads evenly along the irrigation area's perimeter. Flush all lines prior to installation of heads.
3. Support piping without strain on joints or fittings and allow for piping expansion and contraction. "Snake" pipe into trench in accordance to manufacturer's recommendations to allow for expansion. Lay on solid bedding, at uniform depth.

- B. The Contractor shall examine all other portions of working drawings and plan trenching and pipe layout so that no conflict will arise between irrigation and any other work. Any corrective action will be the Contractor's responsibility at no further expense to the Owner.

C. Excavations:

1. Excavations shall be open vertical construction, sufficiently wide to provide clear working space around the work installed and to provide ample space for backfilling and tamping.
2. The use of a vibratory plow or methods other than open vertical trenching will not be allowed without the written approval of the Owner. To obtain such approval, a field test must be performed, at the proposed site, with the equipment to be used in the presence of the Owner and Owner. The field test is to indicate if the proposed site is favorable to the plowing method. Approval for plowing at one location does not allow the use of plowing at another location. Approval for plowing must be obtained for each location where the use of plowing is proposed. If, at previously approved plowing locations, conditions for plowing become unfavorable as determined by the Owner, plowing shall be terminated.

3. Trenches for pipe and equipment shall be cut to required grade lines, and compacted to provide an accurate grade and uniform bearing for the full length of the line.
4. Unless written approval for using native soils as bedding material is given by the Owner, main line pipe shall be placed on a minimum 6 inch depth of granular bedding material.
5. Excess trench soil with rocks greater than ½ inch diameter shall be removed from the planted area and spread as directed by the Owner.
6. When two pipes/conduit are to be placed in the same trench, it is required to maintain a minimum six inch (6") horizontal separation between pipes/conduit.
7. Depth of trenches shall be sufficient to provide a minimum cover above the top of the pipe as follows:
 - a. 24-inch minimum over main lines and wire conduit.
 - b. 18-inch minimum over non-pressure (rotary pop-up) lateral lines.
 - c. 12-inch minimum over non-pressure (pop-up spray head) lateral lines.
 - d. 24-inch minimum from subgrade over any lines located in a paved vehicle area.
 - e. Maximum cover above the top of the pipe shall not exceed twelve inches (12") greater than the required minimum cover.
 - f. 12-inch minimum cover over drip line non-pressure lateral and manifold pipe, and main distribution tubing.
8. Maximum cover above the top of the pipe shall not exceed twelve inches (12") greater than the required minimum cover, unless specifically noted on the drawings.

D. Assemblies:

1. Routing of pressure supply lines as indicated on drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform with details on plans.
2. Install all assemblies specified herein according to the respective detail drawings or specifications pertaining to specific items required to complete the work. Perform work according to best standard practice.
3. Install no multiple assemblies on plastic lines. Provide each assembly with its own outlet.
4. All threaded pipe and fittings shall be assembled using an approved teflon tape, or equivalent, applied to the male threads only. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved teflon tape will be required.
5. No main line elbows, branch tees or isolation valves are to be located closer than five (5) feet to each other without prior approval of the Owner.

E. Line Clearance: All lines shall have a minimum clearance of four inches (4") from each other, and six inches (6") from lines of other trades. Parallel lines shall not be installed directly over one another.

F. Plastic to Steel Connections:

1. At all plastic (PVC) pipe connections, the Contractor shall work the steel connections first. Connections shall always be plastic into steel, never steel into plastic. An approved teflon tape shall be used on all threaded (PVC) to steel, never steel into plastic. An approved teflon tape shall be used on all thread (PVC) to steel pipe joints applied to the male threads only, and light wrench

pressure is to be applied. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved 3/4" wide teflon tape will be required.

2. A non-hardening sealant and lubricant similar to Permatex #51 or LASCO blue pipe sealant may be used in lieu of teflon tape. Apply sealant to clean male threads brushing into grooves and to the first three threads of the female threads.

G. Plastic Pipe:

1. The Contractor shall exercise care in handling, loading, unloading, and storing plastic pipe and fittings. All plastic pipe and fittings shall be stored under a weatherproof roofed structure before using and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lie flat so as not to be subject to undue bending or concentrated external load at any point.
 - a. All lumber, rubbish, rubble, concrete and rocks shall be removed from the trenches by the Contractor. Pipe shall have a firm uniform bearing for the entire length of each pipe line to prevent uneven settlement. Wedging or blocking under riser tees shall be done only if specified on the plans. Pad trenches with soil as necessary to provide uniform bearing surfaces.
 - b. Where extensive lengths of pipe are installed, snake pipe in trench from side to side to allow for expansion and contraction. One additional foot per one hundred (100) feet of pipe is the minimum allowance for snaking. Never lay pipe when there is water in the trench or when the temperature is 32 degrees F or below.
 - c. All changes in direction of pipe shall be made with fittings, not by bending. No main line fittings for changes in direction shall be greater than 45 degrees. Provide a minimum five (5) feet between changes in direction fittings.
 - d. Safely handle primers and cements per ASTM F-402. Make solvent weld joints per ASTM D-2855 with a non-synthetic bristle brush in the following sequence:
 - 1) Make sure pipe is cut square and all rough edges and burrs are removed. All connecting surfaces are properly cleaned and dry prior to application of pipe primer.
 - 2) Apply an even coat of colored primer to pipe and fitting prior to application of solvent.
 - 3) Apply an even coat of solvent to the outside of the pipe, making sure that the coated area is equal to the depth of the fitting socket.
 - 4) Apply an even light coat of solvent to the inside of the fitting.
 - 5) Apply a second coat of solvent to the pipe.
 - 6) Insert the pipe quickly into the fitting and turn pipe approximately one-eighth to one-quarter turn to distribute the solvent and remove air bubbles. Hold the joint for approximately fifteen seconds so the fittings do not push off the pipe.
 - 7) Using a clean rag, make sure to wipe off all excess solvent to prevent weakening at joint.
 - 8) Exercise care in going to the next joint so that pipe is not twisted, thereby disturbing the last completed joint.
 - 9) Allow at least fifteen minutes setup time for each welded joint before moving.
 - 10) Repairing plastic pipe when damaged shall be done by replacing the damaged portion of pipe.

- H. Concrete Thrust Blocks: Concrete anchors or thrust blocks shall be provided on pressure main pipelines 2 inches or greater in diameter at abrupt changes in pipeline grade, changes in horizontal alignment (bends, tees and crosses), reduction in pipe size (reducers, reducing tees or crosses), end-line caps or plugs, and/or in-line isolation valve to absorb any axial thrust of the pipeline. The pipe manufacturer's recommendation for thrust control shall be followed. Thrust blocks must be formed against solid unexcavated earth (undisturbed). Do not enclose entire joint in concrete. Provide a minimum of three cubic feet of concrete for each thrust block.
- I. Concrete thrust blocks may be eliminated if the main line piping system uses self-restrained fittings and bell joint restraints per manufacture's specifications throughout.

3.3 PIPE BACKFILL

- A. Backfill shall not be placed until the installed system has been inspected, pressure tested and approved by the Owner.
- B. Backfill for first 6 inches underneath, and 4 inches around and above main line pipe and control wires shall be granular bedding material, unless the Owner approves in writing that native soil may be used for initial backfill in lieu of granular bedding material. Backfill material for the upper portion of the trench shall be approved soil. Unsuitable material, such as pipe remnants and wire including clods and rocks over two inches (2") in size, shall be removed from the premises and disposed of legally at no cost to the Owner.
- C. Backfilling for all pipe shall be carried out in two basic stages.
 - 8. Stage One Backfilling: This shall be accomplished as soon as possible after the pipe is laid. A bedding of uniform depth with no voids must be provided along the entire length of the pipe. The bedding material should be placed in the trench and tamped into the areas under the pipe, using a suitable tool. Joints should be left exposed until hydrostatic tests are completed. Cover only those portions of the pipe necessary to prevent movement or damage.
 - 9. Stage Two Backfilling: This shall be completed after all hydrostatic tests are completed and the piping system has been thoroughly checked for leaks or other defects. Continue to add backfill material in four inch (4") layers and hand tamp to achieve density similar to adjacent soil. After twelve inches (12") in main line trenches and eight inches (8") in lateral line trenches of hand tamped soil is in place over the pipe and fittings, backfilling can be continued, using light machinery to place dirt in the trenches in six inch (6") layers and to compact the dirt to conform to adjacent soil. Extreme care should be taken to avoid damage to the pipe from machinery that is too heavy. All trenches shall then be water jetted to assure uniform settling and compaction. Backfilling operations will not be considered complete until the top surface has been graded to conform to the adjacent soil. All rocks uncovered and not used as backfill must be collected and removed from the site.
- D. All backfilling shall be done carefully and shall be properly tamped. All soil shall be tamped and puddled to eliminate any voids.

- E. Surplus earth remaining after backfilling shall be disposed of as directed by the Owner.
- F. PVC piping and fittings shall not be backfilled during periods of extreme heat or when a sudden lowering of temperature of the pipe may cause separation of joints or fittings.
- G. Contractor shall fill with properly amended topsoil any irrigation trench that subsides during the warranty period. Contractor shall assume all cost associated with the trench repair, including but not limited to plant replacement of a size of plant disturbed at the time of the repair.

3.4 BACKFLOW PREVENTION ASSEMBLY

- A. Check the existing backflow assembly for leaks or any improper condition. Notify the Owner as such if found.

3.5 CONTROL AND TRACER WIRE, AND COMMUNICATION CABLE

- A. Install control wires alongside of main line piping. Do not tape wires together when encased in sleeve or conduit. Minimum cover shall be 24 inches. Crimp wires together at valve manifold with Scotchlok connector. Conventional valve wire splices shall use a 3M DBY splice kit. Tag all control wire at splices with approved control wire markers.
- B. Wire size shall be determined by the number of valves operating on a given wire and the distance from the controller to the farthest valve, as specified by the charts furnished by the remote control valve manufacturer. Splices are only allowed when rerouting or repairing existing wire. All splice connections must be provided in a valve box.
- C. Communication/sensor cable shall be installed in electrical conduit with long radius sweeps at direction changes and at valve/splice/pull boxes. Maintain a minimum six inch clearance to adjacent pipe. Minimum cover shall be 24 inches.
- D. Install tracer wire along the top of pipe at the following locations:
 - 8. All pipe sleeves.
 - 9. Main line pipe without adjacent control wire.

3.6 VALVES

- E. The Contractor shall make all necessary connections for operation, and shall be connected and aligned to provide the most efficient flow of water to the irrigation heads. Where pressure regulating electric control valves are specified, the Contractor shall adjust the valve so a uniform distribution of water is applied by the heads, and that the most remote heads operate at the pressure recommended by the head manufacturer.
- F. Each valve is to be enclosed in a separate valve box. The valve box shall be secured on firm soil clear of valves and wiring connections. Valve boxes and lids shall be set to finished grade or as indicated on the Drawings. Use valve box extensions of the

same material as the box to the proper depth below the pipeline. Valve boxes shall be supported by common bricks at each corner and at the long side of the box. Use a minimum of six bricks to support rectangular boxes and four bricks to support round boxes. Backfill carefully and properly compact in order to prevent settlement and subsequent damage.

- G. Install a concrete collar around valve boxes when located in asphaltic concrete pavement or in turfgrass areas.
- H. Remote control valve boxes within the field of play at sports venues shall be buried with a minimum of 8 inches of cover over the box lid in turfgrass, and a minimum 3 inches in skinned infield or warning track surfacing.
- I. When existing valve and/or splice boxes are within the area of work, replace in kind any damaged boxes and/or lids, unless noted otherwise. Adjust the elevation of all existing boxes within the area of work to final grade per the drawings.
- J. Locate valve boxes in ground cover/shrub planting areas instead of turfgrass areas whenever possible. Locate valve boxes 18" from and perpendicular to adjacent paving. When grouped together, provide equal spacing of at least 36" between boxes.
- K. Permanently attach the plastic valve identification tag to the remote control valve body and locate so it's clearly visible in an open valve box.
- L. Permanently secure the control valve identification label to the top of concrete valve box lids with non-corrosive connectors.

3.7 AUTOMATIC CONTROLS

- A. Install the controller and/or associated equipment, enclosure, sensors, and accessories per the manufacturer's details and installation requirements, and the construction documents.
- B. Where the controller is not connected to a building's electrical grounding system, install a grounding circuit for controller and associated equipment with either a ground rod or ground plate per ASIC Guideline 100-2002.
- C. Where the new controllers are a site satellite controller in a central control system, the site satellite controller equipment and installation shall be reviewed for system compliance by an authorized central system distributor/installer.
- D. Connect operational control wires or accessory components to the controller, and program valve schedules appropriately for the new planting.
- E. The Owner shall review the fully functional operation of the irrigation control system prior to acceptance of the system, and as a requirement for the start of maintenance.
- F. Install automatic controller chart in laminated or watertight plastic envelope inside controller cover showing which valves are connected to which stations on controller in the work area.

3.8 SPRINKLER HEAD INSTALLATION

- A. Head spacing on drawings is diagrammatic. Head spacing and patterns shall be adjusted to provide complete and adequate coverage with a minimum spray on non-planted areas. Flush all lines prior to installation of heads.
- B. Overhead distribution sprinkler heads shall be installed as detailed, set adjacent to the edge of hardscape elements (2 - 4 inches for spray heads, 6 - 8 inches for rotary heads) and perpendicular to the finish grade. Sprinkler spray heads directed toward a building shall be a minimum 7 feet from building walls, and a minimum 2 feet when directed away from the building. Sprinkler heads in turfgrass areas shall have a minimum 10 foot radius except for corners.
- C. The top of the nozzle in pop-up bodies shall be flush to the finish grade in areas to receive turfgrass seed/stolons, and in ballfield skinned infields. The top of the nozzle shall be one-half inch (1/2") above the finish subgrade in areas to receive standard cut turfgrass sod.
- D. High speed or other sprinkler heads in dust control zones at ballfield skinned infields shall be installed in turfgrass areas where directly adjacent to the skinned infield.
- E. Where individual shrub bubblers are installed, each plant shall have a bubbler within 10 - 14 inches of the shrub center.
- F. Upon completion of the installation, the Contractor shall adjust or change sprinkler head nozzles to uniformly distribute water without overspray and shall place entire irrigation system in first-class operating condition without any additional cost to the Owner.
- G. Sprinkler heads shall be adjusted in order by fully opening the sprinkler furthest from the control valve and working back toward the control valve. Adjust sprinkler heads which spray toward buildings or adjacent hardscape so that water spray does not contact the side of buildings or significantly over-spray onto hardscape .

3.9 BOOSTER PUMP ASSEMBLY AND CONTROLS

- A. The contractor shall coordinate with the pump assembly vendor as to the final layout, orientation and configuration of the pump assembly, control panel, inlet and outlet piping, utility piping and electrical/data conduits to accommodate the existing and/or proposed conditions, equipment and improvements. Pump assembly layout shall comply with code required clearances for existing and proposed equipment. Sawcut, remove and replace in kind any pavement necessary for pipe access, electrical and/or control connections.
- B. Make all necessary modifications and/or rerouting of the supply and discharge piping, either above or below grade, to accommodate the final pump assembly location, orientation and piping configuration with a minimum of direction changes.
- C. Install pump assembly and controls per the design intent of the Contract Documents, the manufacturer's specifications and as shown on the approved Shop Drawings.
- D. A concrete pad shall extend around the entire pump assembly package (all piping and appurtenances) a minimum of 6 inches on all sides. Pad shall be a minimum 8

inches thick with a minimum 6 inches below grade over 6 inches of scarified and compacted soil subgrade. The pad shall have #4 rebar at 24 inches-on-center, both ways. The top of the pad shall be a minimum of 2 inches above the adjacent finish hard surface, or 4 inches above adjacent dirt or DG surface. Secure the pump to the pad with non-corrosive anchor or expansion bolts of the maximum size allowable by the support skid, but at least 0.5 inch diameter.

- E. The Contractor shall be responsible for correct procedures in loading, unloading, stacking, transporting, handling, supporting and securing all materials and equipment to be used in the system. The Contractor shall avoid rough handling which could affect the useful life of equipment. Materials and equipment shall be handled in accordance with the manufacturer's recommendation on loading, unloading, and storage.
- F. A representative of the pump assembly manufacture shall be responsible for all start-up procedures and certifying that the pump operates within design parameters. Pump manufacturer shall train the contractor and Owner in proper pump operation. A startup report containing voltage and amperage readings, suction and discharge pressure readings, estimated flow conditions, and general operating characteristics shall be submitted to the District within 7 days of a successful certification. Contractor shall make all adjustments as necessary for proper pump and controls operation.
- G. The pump vendor shall provide a non-prorated extended warranty for 2 years from the start-up certification. The pump vendor shall guarantee to provide warranty service within three (3) days of a service call request.
- H. The pump vendor shall include an annual service check to perform routine maintenance every 12 months from the date of factory start-up, or on Spring seasonal start-up throughout the warranty period without any cost to the Owner.

3.10 CONCRETE

- A. Concrete shall be installed in accordance with the relevant portions of the Site Concrete specification section.

3.11 COMPLETION AND MAINTENANCE

- A. After the system has been completed but prior to the start of maintenance, the Contractor shall operate the automated system with the Owner, shall instruct the Owner in the operations and maintenance of the system and controls, and shall program the controller for each station.
- B. If site satellite controller(s) for a central control system is installed, an authorized central control distributor/installer shall program the central base station to communicate with the site satellite controller(s), and shall verify that proper communication protocols are operational.
- C. The irrigation system shall be maintained and adjusted as required to provide proper coverage throughout the maintenance period or until Final Acceptance of the project, whichever is greater. Irrigation system maintenance shall commence upon an

acceptable review following the completion of irrigation installation, planting operations and general clean-up.

- D. The maintenance period shall not terminate until the close-out documents and as-built record drawings have been submitted and accepted.

3.12 REPAIR AND CLEAN-UP

- A. All areas shall be maintained in a neat and orderly condition at all times. All reasonable precautions shall be taken to avoid damage to new planting and improvements. Disturbed and/or damaged areas shall be restored to their original condition to the satisfaction of the Owner.
- B. Where trenching or other work disturbs existing and/or newly planted turfgrass and/or planting, the Contractor shall reinstall the existing sod if viable, or install a full width of new turfgrass sod or new planting to match the existing turfgrass/planting species, variety and size, after first conditioning the top 6 inches of soil per the Landscape Planting specification. Adjust finish grades to account for the new turfgrass sod's soil mat so that the new sod is flush to the adjacent turfgrass.
- C. After the irrigation operations are completed, the Contractor shall remove all trash, excess materials, empty containers or any other debris accumulated by the work from the site. All damage caused by the work shall be repaired or material replaced at the Contractor's expense. The site shall be left in a neat and orderly condition to the satisfaction of the Owner.

END OF SECTION

SECTION 32 90 00
LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish all material, labor and equipment necessary to install all landscape work as indicated in the plans and specifications.
- B. The landscape work includes but is not necessarily limited to the following:
 - 1. Soil preparation including cross ripping of all planting soil.
 - 2. Weed control including an application of a pre-emergent herbicide.
 - 3. Providing import planting topsoil at raised grade planters and/or at planting areas needing fill.
 - 4. Fine grading, conditioning and amending planting topsoil.
 - 5. Installation of turfgrass sod.
 - 6. Planting new trees, plants and ground covers.
 - 7. Tree drainage sump boring and testing.
 - 8. Root Barriers.
 - 9. Installation of mulch.
 - 10. Sixty (60) day maintenance.
- C. Related Work Specified Elsewhere
 - 1. Contract Drawings, Addenda, general provisions of the Contract, including General and Supplemental Conditions, and Division 1 Sections apply to work of this section.
 - 2. Section 31 20 00 - Earthwork
 - 3. Section 31 22 22 - Soil Materials
 - 4. Section 32 01 90 – Existing Landscape Protection
 - 5. Section 32 84 00 - Irrigation System

1.2 1.03 DEFINITIONS

- A. Unless noted otherwise, the term "approved" shall mean by the Owner in writing.
- B. Agencies and Organizations:
 - 1. ASTM- American Society for Testing and Materials
 - 2. ANSI – American National Standards Institute
 - 3. ISA – International Society of Arborists
 - 4. SSPWC – Standard Specifications for Public Works Construction, by the American Public Works Assoc./Associated General Contractors of California.
 - 5. TPI – Turfgrass Producers International
- C. Owner: The Owner's authorized representative or authorized consultant.

1.3 QUALITY ASSURANCE

- A. The work of this Section shall be performed by a single firm experienced in landscape planting and holding a current California Contractor's A or C27 License.
- B. Tree and plant quality and sizes shall conform to the current edition of "American Standard for Nursery Stock" for Number One nursery stock as adopted by the American Nursery & Landscape Association (ANSI Z60.1). Plants shall be of uniform, standard size for their listed container size, neither overgrown and root bound or encircling, nor so recently transplanted that the root system is not thoroughly well established throughout the container. Roots should reach the sides of the container and maintain a firm root ball. Pruning shall not be done prior to delivery except by prior approval.

- C. Trees shall also comply with quality characteristics described in "Guideline Specifications for Nursery Tree Quality" current edition, published by the Urban Tree Foundation. Trees not in compliance with any of the following characteristics may be subject to removal and replacement, whether planted or still in their containers.
1. Acceptable caliper and height ranges for the Type, Form and Size of tree.
 2. An intact central leader, or after heading of an old leader, the new leader diameter is greater than one-half the diameter of the old leader. Co-dominant leaders are not acceptable.
 3. Scaffold branch diameters are less than two-thirds the diameter of the trunk, and without included bark at the attachment.
 4. Scaffold branches shall be balanced, well spaced vertically, and with a radially blank section no greater than one-third of the canopy circumference.
 5. Temporary branches on the lower trunk shall be less than three-eighths inch diameter, and the clear trunk height shall be no more than forty (40) percent of the overall tree height.
 6. The root collar and rootball shall be free of defects, including circling, kinked and girdling roots. Roots at the edge and bottom of the container shall be less than one-quarter inch diameter, and uniformly distributed throughout the container.
 7. The tree canopy width shall be a minimum of twenty-five percent of the standard form tree height, except for naturally columnar forms.
- D. Botanical names shall take precedence over common names. Provide plants that are true to name. Tag one representative plant of each species and size with the botanical name and size.
- E. Inspection:
1. All landscape work and materials shall comply with applicable Federal, State, County and City regulations.
 2. All plant material shall be reviewed onsite or by providing photo submittals by the Owner's Representative and/or Landscape Architect prior to positioning and planting. The lack of a review shall not limit the right of rejection during any stage of the work until Final Acceptance for any reason including condition of the foliage or root ball, size, variety, form, appearance, latent defects or injuries or location errors. Rejected or wrongly located plants shall be removed/relocated from/on the site and replaced/replanted immediately by the Contractor as directed at no additional cost to the Owner.
- F. Qualifications of Workers
1. Employ skilled workers who are thoroughly trained experienced in landscape planting and who are completely familiar with specified requirements and methods needed for proper performance of the work in this section.
 2. Provide adequate supervision by a qualified foreman fluent in English that will be continuously onsite during the performance of this work.
 3. Weed control pesticides shall only be applied by an individual holding a valid Qualified Applicator Certificate (Category A) issued by the Department of Pesticides Regulation. Submit a copy of the Certificate.
- G. Any pruning of existing trees specified as part of this Work shall be performed under the direct supervision of an ISA Certified Arborist and in compliance with ANSI A300-Part 1 Standard Practices (Pruning).

1.4 SUBMITTALS

- A. In accordance with the Submittal section, submit:
1. A complete materials list of all items proposed to be furnished including estimated

- quantities.
 2. Laboratory analyses of soil conditioning materials, e.g. organic compost, shall have been performed within three months of the submittal date.
 3. Quality Certificates and/or Certificates of Inspection required by government agencies (providing duplicate copies for the Owner's Representative).
 4. Qualified Applicator Certificate, and DPR Registration Certificates and Material Safety Data Sheets for all pesticides/herbicides proposed for use.
 5. Submit photos with a scale marker of all boxed trees, and a representative photo of each species/variety of ground plane plants proposed for use from the nursery source. Photos shall clearly show the individual tree or plant form without background greenery.
- B. Soil amendments: Submit one (1) pint sample and an analysis of organic compost and mulch.
- C. Other Samples: When requested by the Landscape Architect and/or Owner's Representative.
- D. Soil Fertility Analysis and Recommendations:
1. The Contractor shall provide and pay for a fertility analysis of the existing topsoil and any proposed import planting topsoil. After mass grading operations are completed, native soil samples shall be collected for the fertility analysis by collecting a minimum of 5 representative samples of the soil per acre throughout the area of work. Separate samples shall be produced for cut and fill areas, and for any other area composed of soils not similar to the existing soils. Each sample shall be a minimum of one pint each, and shall be thoroughly mixed together to prepare a homogenous sample. A one quart representative sample for cut, fill and any other special conditions shall be submitted to the soil testing laboratory as a representative sample for fertility analysis. The fertility analysis shall at a minimum provide the following data:
 - a. soil texture class and percent sands, silts and clays per ASTM D422
 - b. estimated soil infiltration and percolation rates
 - c. pH
 - d. organic matter (%)
 - e. total soluble salts (ECe)
 - f. Cation Exchange Capacity (CEC) and Percent Cation Saturation for K, Mg, Ca and Na
 - g. major and minor nutrients (ppm).
 2. Recommendations for improvement of the soil conditions for optimum plant growth shall be made by the testing laboratory, and at a minimum shall include the following:
 - a. A fertilizer and amendment application program (including macro and micro nutrients) for both pre-planting and maintenance fertility applications for broad area tillage and for planting pit backfill (pre-plant only).
 - b. Treatments to neutralize soil pH and to correct any adverse conditions as warranted.
 - c. Recommendations shall address soil conditioning for both planting area tillage and tree/plant planting pit backfill.
 3. The soil analysis and recommendations shall be performed by one of the following laboratories capable of providing the above analyses by a licensed soil scientist:
 - a. D&D Agricultural Laboratory. Contact Darrin Peters at 559-348-1818.
 - b. Wilber-Ellis Company. Contact Michael Cline at 209-442-1220.
 4. The Contractor shall submit the results of the soil testing investigations and shall receive written direction from the Landscape Architect before proceeding with any soil conditioning activities such as fertilizing and/or tillage of amendments.

- E. Within seven days from the start of the maintenance period, submit a calendar of maintenance activities, including scheduled dates for mowing, fertilizing, weed control and all other activities. Provide the quantities of maintenance fertilizer and any other materials scheduled to be used in each application during the maintenance period.
- F. Submit invoices and/or delivery tags from material suppliers for all amendments, fertilizer, seed, plants, mulch and any other materials provided for the landscape planting installation and applied during the maintenance period. Submit tags from seed packaging indicating seed varieties, percent purity and percent germination minimums. The invoices and/or delivery tags shall be provided directly to the Owner's Representative/Inspector of Record within 24 hours of delivery to the site, as well as to the normal submittal recipients per the Contract Documents.
- G. Close-out Documents: Submit prior to the end of the maintenance period. Acceptance of the Close-out documents in a condition for scheduling a Final Acceptance review. Provide two bound copies of the following:
 - 1. Cover sheet stating Contractor's address and telephone number, duration of guarantee period, and a list of plant nurseries, materials and equipment vendors with names and addresses of the vendor/manufacture representatives and warranty periods.
 - 2. A "CERTIFICATE OF CONSTRUCTION COMPLIANCE" which indicates that all work done, materials and equipment used and installed are in compliance with the approved plans, specifications and all authorized revisions.
 - 3. Maintenance Manuals and Instructions: Submit a monthly schedule of procedures to be established by Owner for maintenance of landscapes (trees, mixed planting and turfgrass) for one full year and shall include recommendations for fertilizing, pest and disease control, weeding, mowing, aeration and top dressing.
 - 4. Soil Amendment and/or Seed/Stolon confirmation form noting the installed quantities of materials, tags or invoices from Subsection F. above, and the person who confirmed the delivery and installation of the materials.
 - 5. Operations and Maintenance Manuals and Warranty certificates for any maintenance equipment turned over to the Owner.
 - 6. As-built Record Drawings with all modifications to the Drawings noted in red ink, and the Landscape Planting Observation Log completed.

1.5 AVAILABILITY

- A. The Contractor shall confirm availability of plants, supplies, and materials prior to submitting his landscape bid. Plant variety substitutions are not desired.
- B. If a plant is found not to be suitable or available, the Contractor is to notify Landscape Architect before bidding. The Landscape Architect is then required to select a reasonable alternate and to inform all those bidding of the availability of the original plant. If a substitute is selected it must be of the same size, value and quality as the original plant. Failure to inform the Landscape Architect of unavailable plants prior to bidding will require that all plants specified shall be provided by the Contractor at time of installation.
- C. Plant container size listed on construction documents are minimum acceptable size. If plant material specified is not substituted prior to award of the contract the minimum container size specified shall be provided by the Contractor. If the Contractor can not provide the minimum specified size plant material at the time of installation, the Contractor shall be required to install a larger size container of the plant specified at no additional cost to the Owner.

1.6 EXISTING CONDITIONS

- A. The Contractor is to visit the job site to verify existing conditions including soils, vegetative growth, subsurface conditions, existing grade and drainage, irrigation system etc. making allowances in his bid for any required work to provide the landscape installation as specified in the construction documents.
- B. The Contractor shall notify the Owner to locate underground lines prior to hole boring or trenching. Do not permit heavy equipment such as trucks, rollers, or tractors to damage utilities. Hand excavate as required to minimize possibility of damage to underground utilities. Maintain grade stakes set by others until removal is mutually agreed upon by all parties concerned. Prevent damage to temporary risers of underground irrigation system and similar obstructing work located in the landscape areas.
- C. If there is a conflict with existing utilities, improvements and/or planting and the proposed planting, Contractor shall promptly notify the Owner's Representative for instructions as to further action. Failure to do so will make Contractor liable for any and all damage or corrective actions arising from his operations.
- D. Prior to the start of this work, the Contractor and the Owner's Representative shall verify the operational condition of that portion of the existing irrigation system pertaining to the proposed planting area. The Contractor shall notify the Owner's Representative of any repairs and/or corrections necessary for proper functioning and coverage. The repairs and/or corrections shall be completed before any plant material is planted. Failure to perform system verification and provide notification prior to the start of this work will make the Contractor liable for any and all repairs and/or corrections necessary for proper functioning and coverage, as well as any required plant replacement, without any additional cost to the Owner.
- E. No plants shall be planted in situations that show poor drainage infiltration or low areas that result in standing water. Such situations shall be corrected by the Contractor as directed by the Landscape Architect or Civil Engineer. Failure by the Contractor to notify the Owner of poor drainage conditions prior to proceeding with the conditioning or planting operations shall place the responsibility for any plant removals, additional soil conditioning and replanting on the Contractor without any additional cost to the Owner. Any corrections of finish grading not in compliance with the Contract Documents including plant removal, soil conditioning and replanting shall be performed by the Contractor at no additional cost to the Owner.

1.7 PROTECTION

- A. The Contractor shall guarantee repair of damage to any part of the premises resulting from but not limited to leaks, defects in materials or workmanship, operation of equipment, storage of materials and/or equipment, installation of underground or overhead utilities. The Contractor shall be liable for any and all accidents resulting from his work, including open holes and trenches during construction.
- B. Protect new and existing landscape areas in the area of work from theft, loss, damage and deterioration during storage, installation and maintenance. Protect from unauthorized persons (trespassers) as well as from operations by other contractors and tradesmen, and landscape operations. Protect all planted turf and shrub areas from persons as well as operations of other contractors and the Owner. Cost of protection shall be born by the Contractor with means of protection such as temporary fencing as approved by Owner. Cost for protection shall be included in the Contractor's bid for the work.
- C. Contractor shall repair or replace damaged work and/or damage to existing improvements/landscape as identified by the Owner's Representative to a condition acceptable to the Owner's Representative. No additional payment will be made to the

Contractor for repair or replacement of damaged work and/or damage to existing improvements/landscape.

1.8 OBSERVATIONS

- A. General:
 - 1. Installation and operations must be approved by the Owner.
 - 2. In no event shall the Contractor cover up or otherwise remove from view any work under this contract without prior approval of the Owner. Any work covered prior to inspection shall be opened to view by the Contractor at his expense.
 - 3. In all cases, where inspection of the landscape planting work is required and/or where portions of the work are specified to be performed under the direction and/or review of the Owner, the Contractor shall notify the Owner at least 72 hours in advance of the time when such inspection and/or direction is required. Any necessary re-excavation or alterations to the planting needed because of failure of the Contractor to have the required inspection, shall be performed at the Contractor's own expense.
- B. The Owner or the Project Inspector shall perform periodic observations and shall record the observation on the Landscape Planting Observation Log form on the As Built Record Drawings. Field Reports by the Owner's Representative noting the observations may be acceptable if included in the Close-out Documents. Such observations shall include but are not necessarily be limited to:
 - 1. Weed control operations prior to other portions of work.
 - 2. Ripping and soil conditioning of the planting area.
 - 3. Layout of the plant material and trees at the site prior to planting in order to avoid conflicts and to meet the design intent.
 - 4. Condition and quality of plant material prior to planting.
 - 5. Auguring, digging and preparation of plant pits and drainage sumps for trees and shrubs.
 - 6. Planting and staking of trees.
 - 7. Planting of shrubs, ground cover and turfgrass.
- C. Any corrective action called for shall be immediately performed by the Contractor.
- D. Failure by the Contractor to obtain the above observations shall place the responsibility on the Contractor for any relocation and/or replacement of planted trees or shrubs.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Plant label shall identify each species and variety. A label shall be attached to each individual plant or block of identical plants grouped together.
- B. Adequately protect plants from sun and wind prior to planting. Do not allow stored plant material to dry out at any time.
- C. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at the site. Store materials and equipment in a location as directed by the Owner's Representative.

1.10 PESTICIDE NOTIFICATION

- A. A written notification of any and all pesticide/herbicide products scheduled for use by the Contractor or their representative on the Owner's property must be submitted to the Owner's Representative at least seven days prior to the scheduled application. Notification

shall include the product name, manufacturer's name, the pesticide active ingredient, the U.S. EPA and CalDPR registration numbers, the scheduled date and application areas, and the reason (target species) for the application.

1.11 REPAIR OF DAMAGED EXISTING PLANTING AREAS

- A. The Contractor shall be responsible to repair all damage and/or distress to existing planting areas including turfgrass, shrubs, ground covers, perennials, etc., whether specifically shown on the Contract Documents or not, as a result of construction operations, material and/or equipment storage, site access, site offices, utility and/or irrigation line installations or other actions.
- B. Replacement shrubs shall be 15 gallon size, replacement ground cover and perennial plants shall be 5 gallon size, and turfgrass shall be full width sod. Damaged areas shall be amended and finish graded per the Contract Documents prior to planting. Damaged areas outside of the limit of work shall be returned to the pre-construction condition with new replacement plants and/or turfgrass sod. Non-turfgrass planting areas shall also receive wood mulch as specified herein. The limits of repair shall be determined by the Owner.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Topsoil used in planting areas shall be a clean, friable soil with no noxious weeds, clods or stones larger than 0.5 inch in diameter, subsoil, hardpan, wood, debris, fine organic material greater than 5%, undesirable insects, plant disease or any other natural or extraneous objects detrimental to normal plant growth to a minimum depth of 18 inches from finish grade.
- B. The Contractor shall provide a particle size analysis, fertility testing and amendment recommendations of proposed native and/or import topsoil, and the Landscape Architect reserves the right to reject topsoil not conforming to the minimum specifications. Stockpiled onsite topsoil may be used if analysis and testing determines compliance with these requirements prior to placement. Failure to meet minimum specifications shall result in the removal of any unauthorized placed topsoil at the Contractors expense.
- C. Particle size distribution for topsoil shall meet the following per ASTM D422:
 - 1. 100% passing a 12.2 mm (1/2") screen.
 - 2. Minimum 95% passing a 9.5 mm (3/8") screen.
 - 3. Minimum 75% passing a 2.36 mm (No. 8) screen.
 - 4. Maximum 45% passing a No. 200 screen.
 - 5. Silt content shall be a maximum 35%.
 - 6. Clay content shall be a maximum 25%.
 - 7. Silt to Clay ratio shall be less than 2 and greater than 0.5.
- D. Other characteristics shall conform to the following:
 - 1. Permeability rate shall be not less than one (1.0) inch per hour or not more than 20 inches per hour.
 - 2. The sodium absorption ratio (SAR) shall not exceed 3.0 and the electrical conductivity (ECe) shall not exceed 2.5 milliohms per centimeter at 25 degrees centigrade.
 - 3. Soluble boron shall be no greater than 1.0 part per million (mg/l).
 - 4. Soil pH range shall be 6.5 – 7.9.
 - 5. Maximum concentration of soluble chloride shall be 150 parts per million.
 - 6. Maximum concentration of heavy metals shall not exceed the following when the pH is between 6 and 7:

a.	Arsenic:	0.5 ppm
b.	Cadmium:	0.5 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

7. Petroleum hydrocarbons shall not exceed 100 mg/kg dry soil.
8. Aromatic volatile organic hydrocarbons shall not exceed 2 mg/kg dry soil.

2.2 SOIL AMENDMENTS

- A. Organic Compost: "Harvest Premium" as supplied by Harvest Power (559) 435-1114; "WonderGrow Compost" by Grover, Inc. (866) 764-5765, or "Allgro Compost" by Synagro (559) 341-5158, or approved equal and conforming to the following minimums per the US Composting Council 'Compost Technical Data Sheet' report dated within three months of the submittal date:
 1. Certified as "Mature" or better
 2. Pass EPA Class A standards for pathogens and heavy metals.
 3. Particle size: 1/8" maximum
 4. pH: 6.0-7.5.
 5. Macro-nutrients: Minimum of 1.0% Nitrogen, 0.5% Phosphorus, 0.5% Potassium.
 6. AgIndex ratio (Nutrients/Salts) 10 or more.
 7. Ammonia N/Nitrate N ratio: rated Mature or Very Mature
 8. Organic matter content greater than 50% dry weight.
 9. Ash: equal or greater than 6%, not greater than 20%
 10. Carbon/Nitrogen ratio: less than or equal to 25.
 11. Salinity (ECe): less than 10.0 dS/m.
 12. Odor shall be soil-like (musty, earthy) without any sour, ammonia-like or putrid smell.
- B. Gypsum shall be mined agricultural grade gypsum composed of no less than 95% $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ hydrated calcium sulfate in a pelletized form. Elemental Sulfur shall be a minimum 95% pure agricultural grade.
- C. Dry Humate organic soil conditioner comprised of a minimum 70% humic acid from Leonardite.
- D. Endo 120 Mycorrhizae containing a minimum 60,000 living propagules per pound.
- E. Amendment material types and application rates may be subject to change based on the findings and recommendations of the horticultural soil testing lab, and as such may result in an increase or decrease in the Contract Amount.

2.3 FERTILIZER

- A. Trees and Shrubs: Fertilizer for all trees and shrubs to be BEST PAKS (20-10-5) controlled release fertilizer in a biodegradable 10 gram packet. The BEST PAKS shall be applied at the following rates:
 1. 1 Gallon Can: 1 Best-Pak
 2. 2 Gallon Can: 2 Best-Paks
 3. 5 Gallon Can: 5 Best-Paks
 4. 15 Gallon Can: 10 Best-Paks

5. 24" Box: 16 Best-Paks
 6. 36" Box: 24 Best-Paks
- B. The pre-plant fertilizer shall be a commercial homogeneous, granular pellet:
1. Pre-plant fertilizer for turfgrass shall be:
 - a. BEST 6-24-24-5S XB+ with Avail
 2. Pre-plant fertilizer for mixed plantings shall be:
 - a. BEST Landscape Color 14-14-14 (14-6-11.6-3S and micronutrients) with 9.9% slow release N, or equal.
- C. The maintenance fertilizer shall be a commercial homogeneous, granular pellet:
1. Maintenance fertilizer for turfgrass shall be one or more of the following:
 - a. Urea 46-0-0
 - b. BEST Ammonia Sulfate 21-0-0-24S, standard grade, or equal
 - c. BEST Nitra King 21-2-4-14S-2Fe, or equal.
 - d. BEST Nitex 20-2-3-12S-5Fe, or equal.
- D. Fertilizer material types and analysis may be subject to change based on the findings and recommendations from the horticultural soil testing lab, and as such may result in an increase or decrease in the Contract Amount.

2.4 MULCH

- A. Mulch for on-grade or raised native soil planters shall be a walk-on type of chipped and aged greenwaste woody material without leaves, green wood, sticks, dirt, stones, dust and other non-organic debris as accepted by the Landscape Architect. Particle size 1/2" to 3" in general size.

2.5 STAKING & GUYING MATERIALS

- A. Stakes: 2" Diameter Lodgepole Pine or Douglas Fir, pressure treated and pointed one end.
- B. Ties: V.I.T. Cinch Tie, 32 inches long, V.I.T. Products, Inc. (619) 673-1760, or equivalent.

2.6 PLANTS

- A. Plants shall be typical of their species and variety, shall have normal growth habits, well developed branches and be densely foliated, and shall have fibrous root systems. No substitutions will be allowed unless approved in writing by the Landscape Architect.
- B. Plants shall be free from defects and injuries including disease, insects, insect eggs and larvae and girdled or matted roots.
- C. Quality and size of plants shall be in accordance with ANSI Z60.1-2004, "American Standard for Nursery Stock", and as described in Quality Assurance.
- D. Plants shall not be pruned before planting.
- E. Plant material must be selected from nurseries that have been inspected by State or Federal Agencies.
- F. Plants shall be nursery grown and shall have been transplanted or root pruned at least once in the past three (3) years. Plants shall have been grown under climatic conditions similar to those in the locality of the project.
- G. Each bundle of plants shall be properly identified by weatherproof labels securely attached

thereto before delivery to the project site. Label shall identify plant by name.

- H. Nomenclature shall be in accordance with Sunset Western Garden Book, current edition.
- I. No plants shall be removed from their container until a review has been made in the field or at the nursery, or except when specifically authorized in writing by the Owner.
- J. Collected plant material may be used only when approved. Approval shall not limit the right of rejection during work progress for conditions of the root ball, latent defects or injuries.
- K. Where shown a "MULTI" provide trees with a minimum of three trunks.
- L. Plant sizes listed on the planting plan are minimum acceptable sizes. The quantities listed are the Landscape Architect's estimate only. The Contractor is responsible for the quantities of plant symbols shown on the plan, and/or the quantities in hatched planting areas at the specified triangular spacing.

2.7 TURFGRASS SOD

- A. Sod shall be produced from certified or approved seed/stolons, fresh and labeled in accordance with U. S. Department of Agriculture Rules and Regulations. Sod quality shall be Premium or Standard Grade per TPI specifications.
- B. Sod shall be neatly mowed and be mature enough that when grasped at one end it can be picked up and handled without damage, delivered to the project site, adequately protected and installation commenced within 24 hours of harvesting.
- C. Turfgrass shall be a species and variety as specified in the Contract Drawings. If a warm-season grass is specified and the installation is to be performed between the months of October and April, a species with an established perennial ryegrass overseeding shall be installed. Submit the overseeded product information for approval prior to the installation.

2.8 ROOT BARRIER

- A. A ribbed polyethylene panel of minimum 0.080" thickness equal to Deep Root Partners #UB 24-2 PANEL, (800) 458-7668..

2.9 TREE TRUNK PROTECTOR

- A. ArborGard+ polyethylene tree guard by Dimex (800) 334-3776, or equal.

2.10 HERBICIDES

- A. Herbicide products for removal of unwanted grass and broad-leafed weeds shall be registered and approved for use by the U.S. EPA and CalDPR, and shall comply with the Owner's Standards and with the "Healthy Schools Act" with current amendments, and with the current list of prohibited herbicides at Schools and Child Care facilities per California Assembly Bill 405.
- B. Provide pre-emergent and post-emergent, selective herbicide formulations for use on turfgrass areas and/or ornamental shrub/ground cover areas that are not injurious to the proposed plantings and turfgrasses.
- C. Provide a non-selective contact herbicide formulation only for use to remove existing established weeds prior to new plantings. The herbicide shall be certified for organic use,

broad-spectrum with systemic function, 'Weed Slayer' by Agro Research International, or equal.

2.11 OTHER MATERIALS

- A. Materials not specifically indicated, but necessary for proper execution of the work, shall be of first quality as selected by the Contractor subject to approval of the Landscape Architect.

PART 3 - EXECUTION

3.1 EXAMINATION & PREPARATION

- A. General: Verify that existing site conditions are as specified and indicated before beginning this work.
- B. Damaged Earth: Verify that earth rendered unfit to receive planting due to concrete water, mortar, limewater, hydrocarbons or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the Owner's Representative.
- C. Examine the area and conditions under which the work in this section is to be performed. Verify that any existing irrigation system within the limit of work is in proper working order with full coverage. Correct conditions detrimental to the timely and proper completion of the work. Do not proceed until unsatisfactory conditions have been corrected. Commencement of the work signifies acceptance of the existing conditions.
- D. Protection:
 - 1. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment within the area of work prior to commencing work.
 - 2. Mark existing irrigation heads, valves, valve boxes and other below grade equipment or components that are scheduled to remain. Protect in place.
- E. Runoff and Erosion Control: Furnish equipment, materials and labor necessary to control the flow, drainage, and accumulation of excess water running off the work area and prevent soil erosion, blowing soil and accumulation of wind-deposited material on the site per the approved SWPPP.

3.2 ROUGH GRADING, SOIL PREPARATION, PLANTER BACKFILL

- A. Rough grading shall be performed by other subcontractors to the extent of establishing rough pads, slopes and drainage patterns. The Contractor is responsible for placement of topsoil and grading required to ensure positive drainage in all turfgrass and planting areas. All planting areas shall have a minimum topsoil depth of 18 inches from on-site native and/or approved import sources. Rough grading shall be completed prior to weed control, cross ripping or rock removal operations.
- B. After the completion and acceptance of the weed control operations outlined below, and unless directed otherwise by the Landscape Architect or noted on the Drawings, and except for the area under the canopy of existing trees, the Contractor shall cross rip and till (break up large clumps and clods in excess of 2 inch diameter) the existing soil within all planting areas outside the canopy drip line of existing trees until the soil is loose and friable. Ripping shall be to a minimum depth of twelve inches (12") in turfgrass areas and eighteen inches (18") in shrub/ground cover areas, with ripping tines a maximum 18" apart performed in a minimum of two passes total in different perpendicular directions. The Contractor shall review the completed ripping operation with the Owner's Representative and Landscape Architect to determine compliance. The first 6 inches of any new topsoil fill shall be tilled into the existing soil to a minimum depth of 6 inches prior to placing any

further topsoil fill. The Contractor shall provide any additional work as directed by the Owner's Representative after the review to obtain compliance. Do not proceed with the addition of topsoil and/or amendments, or commence rock picking or fine grading until the completed ripping operation is accepted in writing by the Owner's Representative.

- C. Planting area soil under the canopy drip line of existing trees, or in planting beds not accessible by motorized equipment, shall be ripped to a minimum depth of 12 inches using manual spading shovels, forks and/or broadforks and working around major tree roots and/or utilities. In areas receiving new mulch, rip to a minimum depth of 4 inches while protecting any existing plants and their root system. Break up and/or remove rocks and clods as indicated below.
- D. Do not work soil when moisture content is so great that excessive compaction will occur, or when it is so dry that dust will form in air or clods will not break up readily, or when a full ripping depth cannot be achieved. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and dust control. Maintain within 2 percent above or below optimum moisture content for the existing soil type at all times during the work.
- E. After soil ripping and preliminary finish grading is completed, the topsoil shall be cleared of all concrete, wire, sticks, roots, debris and foreign materials. Remove native stones and clods as follows:
 - 1. In shrub/ground cover areas, remove stones and clods greater than one (1.0) inches in diameter from the top 3 inches of finish grade.
 - 2. In general, non-play or sport turfgrass areas, remove stones and clods greater than three-quarter (0.75) inch in diameter from the top 2 inches of finish grade.
 - 3. In designated play or sports field turfgrass areas, remove stones and clods greater than one-half (0.50) inch in diameter from the top 4 inches of finish grade using a mobile tractor pulled, PTO powered, hydraulic controlled rock picker, Cherrington Model 4500 or similar.
- F. Add clean planting topsoil where needed to bring grade to elevation to promote positive drainage. Spread approved planting topsoil over ripped subgrade prior to incorporating amendments.
- G. Backfill all raised grade planters with a minimum depth of 18 inches of imported clean sandy loam planting topsoil conforming to Subsection 2.02 and approved prior to import and/or placement. Failure to obtain import approval prior to backfilling raised grade planters shall result in the removal of any planting and non-approved backfill, and the reinstallation of the work with approved materials.

3.3 WEED CONTROL

- A. Weed control pesticides shall only be applied by an individual holding a valid Qualified Applicator Certificate (Category A) issued by the Department of Pesticides Regulation.
- B. The Contractor shall treat any weeds in proposed new turfgrass and planting areas with a non-selective contact weed killer at the manufacturer's approved rates and procedures prior to any commencement of work at the site including any irrigation work, ripping of soils or fine grading. Areas planned for turfgrass seed/stolon planting shall in addition receive "grow and kill" weed removal as outlined below.
- C. Weed eradication shall be ongoing throughout the course of the landscape installation. The Contractor shall apply a pre-emergent herbicide after shrub/ground cover planting and prior to mulch installation. Manually remove weed seed heads. At no time will weeds be allowed to become established. Contractor shall provide all weed control operations as directed by the Owner's Representative.

- D. All weed control operations using pesticides/herbicides shall comply with the CalDPR and Owner Standards. As well as AB2260 "Healthy Schools Act". The Contractor shall comply with the notification and posting requirements of the "Healthy Schools Act".
 - 1. The Contractor shall notify the Owner per Subsection 1.11, A.
 - 2. The Contractor shall post highly visible signs around the treatment area in conformance with the "Healthy Schools Act" warning of a scheduled pesticide/herbicide application a minimum of 24 hours before to 72 hours after a pesticide application.
- E. A non-selective contact herbicide for grassy weeds, '20% Vinegar Weed Slayer' by Good Natured, CA DPR Reg# 85208-1-AA-42177, shall be applied directly to the weed foliage. Only apply to dry surfaces, and a minimum of 8 hours before a rain event. Allow a minimum of 14 days from herbicide application to commence any planting.
- F. Perform pre-plant clearing and weed control for native open ground areas planned to receive planting as follows:
 - 1. Apply irrigation to encourage weed growth prior to ripping, and to maintain moisture in the soil.
 - 2. Apply a contact herbicide to weed foliage. Remove weeds and expose bare soil.
 - 3. Lightly disk/till to a depth of three-inches.
 - 4. Perform a "grow and kill" operation after the first disking/tillage:
 - a. Water and lightly fertilize to encourage weed germination.
 - b. Follow with a second application of a contact herbicide.
 - c. Remove weeds and perform a light harrowing or disking.
 - 5. Apply irrigation to encourage weed growth. If additional weeds germinate, perform a second "grow and kill" operation.
 - 6. Once existing weeds are completely removed, obtain authorization from the Owner's Representative to proceed with deep ripping, rock removal, soil conditioning and finish grading operations. Allow a minimum of 14 days from herbicide application to commence any planting.
- G. After the shrub/ground cover planting is complete and prior to mulch installation, apply an approved pre-emergent herbicide per the manufacturer's recommended rates.

3.4 SOIL CONDITIONING

- A. Before commencement of any soil conditioning, weed and rock removal shall be completed as outlined above.
- B. Uniformly amend the entire area of topsoil in turfgrass and mixed planting areas per the following bid rates and per the approved modifications as a result of the soils analysis recommendations:
 - 1. Turf and Non-Sloped (less than 4h:1v) Planting Area Soil Conditioning (per 1,000 square feet).
 - a. Compost at a rate of six (6.0) cubic yards (a 2.0 inch thick layer).
 - b. Gypsum at a rate of 100 pounds, or Sulfur at 19 pounds, or an equivalent combination.
 - c. Humate soil conditioner at a rate of fifteen (15) pounds.
 - d. A pre-planting fertilizer to turfgrass areas at a rate of 1.25 pounds of actual P and K.
 - e. A pre-planting fertilizer to mixed planting areas at a rate of 1.5 pound of actual N.
 - f. Mycorrhizae per Subsection 3.06, Mycorrhizae Application.
- C. Till soil amendments into the entire planting area soil to a minimum depth of six (6) inches. Perform the cultivation in at least two passes, one in each perpendicular directions to the

first, so that the amendments are homogeneously incorporated into the topsoil. All cultivation inside the dripline of existing trees shall be preformed manually with minimal disturbance to the root system.

- D. Planting backfill for trees and shrubs shall be a mix of three parts native soil and one part Compost by volume. Add Humate at 2.0 pounds, and Mycorrhizae at 0.5 pounds cubic yard of backfill.
- E. Amendment material types and application rates may be subject to change based on the findings and recommendations of the horticultural soil testing lab, and as such may result in an increase or decrease in the Contract Amount.

3.5 FINE GRADING

- A. Upon completion of soil preparation, fine grade all planting and turfgrass areas to a smooth and even slope conforming to and establishing drainage patterns per the approved Grading Plan. Grading shall eliminate all humps and hollows and promote positive drainage in all planting and turfgrass areas.
- B. Where hardscape is installed in existing mixed planting areas, a minimum transition grade width of 2 feet adjacent to the edge of hardscape shall be constructed unless noted otherwise. The maximum slope of any transition grade in mixed planting areas shall be 20 percent (1v:5h). The area of transition grading shall be planted or repaired as specified herein.
- C. Tolerance of grade differential for planting and general turfgrass areas shall be plus or minus 0.04 foot. If requested, the Contractor shall water test all turf and planting areas after the grading operations are completed in the presence of the Owner's Representative and/or Landscape Architect. The water test shall consist of applying water to the turf and planting areas to the point where water begins to run over the soil to show the drainage pattern. Make all corrections to the finish grading as required by the Owner's Representative to re-established positive drainage patterns. Acceptance of the finish grading shall be obtained in writing from the Owner's Representative and/or Landscape Architect prior to proceeding with soil conditioning and planting operations.
- D. Turfgrass sports fields shall be fine graded using a laser controlled machine capable of producing final grades within 0.02 foot plus or minus from the proposed elevations. The Contractor shall provide an as-graded topographical survey with finish elevations shot on a 25' grid and along transition edges to confirm that the finish grading complies with the design grades with allowances for sod soil mat thicknesses, etc. The Contractor shall allow seven (7) working days in their contract schedule for the as-graded survey to be evaluated and returned to the Contractor and Owner. Acceptance of the finish grading shall be obtained in writing from the Owner's Representative and/or Landscape Architect prior to proceeding with soil conditioning and planting operations.
- E. After the finish grading process, relative compaction of the soil in turf and planting areas shall range between 82% and 85% relative density. Compaction/moisture levels are generally acceptable if an Oakfield probe is able to penetrate a minimum of six inches into the cultivated planting topsoil with moderate pressure. The Owner reserves the right to require the Contractor to test for over compaction. If the compaction is within the acceptable range, the test will be paid for by the Owner. All testing due to non-compliance will be paid for by the Contractor.
- F. Remove all rocks produced as a result of the soil conditioning and finish grading operations per the requirements of Subsection 3.02.

- G. Finish grades shall be one-half inch (1/2") to three-quarter inch (3/4") for turfgrass sod areas, flush (0.0") for turfgrass seed/stolon areas and two inches (2") for shrub/ground cover planting areas below the finish surface of all adjacent walks, curbs, mowstrips and utility/valve boxes or collars. Transition any non-compliant grade in existing turfgrass areas at a maximum 12h:1v slope to meet finish grades above, unless shown otherwise on the grading plan.

3.6 MYCORRHIZAE AND HUMATE APPLICATION

- A. In turfgrass planting areas, after fine grading is completed broadcast Mycorrhizae at a rate of one and one half (1.5) pounds per 1,000 square feet (65 lbs. per acre). Lightly rake into the top one inch (1") of topsoil immediately prior to turfgrass installation.
- B. In shrub and/or ground cover planting areas, the Mycorrhizae inoculant shall be incorporated into the soil with the other soil amendments at five (5.0) pounds per 1,000 square feet (218 lbs. per acre) per Subsection 3.04, Soil Conditioning. Inoculant shall also be incorporated into the planting backfill per Subsection 3.04, E.
- C. In areas receiving turfgrass renovation/aeration, broadcast Humate at a rate of ten (10.0) pounds per 1,000 sf in conjunction with the sand/compost topdress application prior to spreading operation.
- D. In existing mixed planting areas where new mulch is to be installed, broadcast and rake Humate into the top 2" of planting soil at a rate of five (5.0 lbs) per 1,000 sf prior to the new mulch installation.

3.7 PLANTING

- A. General Requirements
 - 1. Obtain written approval from the Landscape Architect or Owner's Representative to begin planting operations. The irrigation system shall be fully automated and operational, all weeding, soil conditioning and finish grading completed, and the tree and plant layout approved.
 - 2. Planting shall be performed by workmen familiar with planting procedures and under the supervision of a qualified foreman. The planting foreman shall be on the job site at all times when planting is in progress.
 - 3. Planting operations shall not occur under unfavorable weather conditions.
 - 4. Boxed trees shall be planted first. Shrub planting shall be completed before groundcover is planted.
 - 5. Proceed and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of planting required.
 - 6. Cooperate with other contractors and trades working in and adjacent to the planting work areas. Examine drawings which show the development of the entire site and become familiar with the scope of other work required.
- B. Planting Preparation and Operations
 - 1. Planting material shall be provided with adequate protection of root system and balls from drying winds and sun. Do not bend or bind trees or shrubs in such a manner as to damage bark, break or destroy natural shape. Provide protective covering during delivery.
 - 2. Deliver trees and shrubs after preparations for planting have been completed, and plant immediately. If planting is delayed more than six (6) hours after deliver, set trees and shrubs in shade, protect from weather and mechanical damage and keep roots moist. Do not remove container grown stock from containers until planting time.
 - 3. All planting areas shall be smooth and even. Finish grades shall be done prior to

- any placement of plants.
4. Place all trees and shrubs in locations shown on the planting plan and obtain written field approval of the Landscape Architect before planting or digging planting pits. Inform the Landscape Architect seven (7) days prior to placing the plants. Maintain a minimum 15 foot clearance from trees to any light pole, unless specifically noted otherwise.
 5. Carefully remove all canned stock from containers with tin snips or approved cutter. Cut away and remove any girdled or matted roots.
 6. Excavate holes of circular outline with vertical sides for all plants 15 gallon or less. Boxed trees shall have square planting holes. The vertical sides and bottom of the holes shall be thoroughly scarified to promote union of backfill with existing soils. All trees shall have two drainage sump holes drilled with a twelve inch (12") diameter auger penetrating hardpan layers to a minimum one (1) foot into a sand/gravel layer or to a minimum depth of ten (10) feet below the planting pit bottom. Precautions shall be exercised to avoid smooth sides on the holes. Offset augured holes a minimum of eighteen inches (18") from planned tree location to avoid settling of tree after planting.
 7. After cleaning out the sump holes, the Contractor shall test the sumps for drainage by flooding with water. If the water does not drain out within twenty-four (24) hours, auger down as required to achieve such drainage by breaking through the hardpan layer, or by extending the drainage sumps to a minimum depth of 15 feet below the bottom of the planting pit. After obtaining approval of the sump holes, fill the augured drainage sump holes with coarse concrete sand.
 8. Tree and shrub planting pits shall be at least two and one half (2.5) times the width of the plant container, but a minimum of 36" wide for trees and 18" wide for container shrubs. Planting pits shall be as deep as the soil depth in the container or box, less the additional height of the crown above the finish grade.
 9. Set each plant in the center of the pit, plumb and straight. Set the crown of the plant at one inch (1") for shrubs, two inches (2") for trees above finish grade. When 1/2 of the backfill mix has been placed, tamp-in, insert fertilizer (BEST PAKS as per Section 2.1B1) and allow no air pockets as remainder of backfill is added.
 10. Compact soil around the rootball of all plants and thoroughly water in the entire backfill depth.
 11. Excess soil from plant holes shall be cultivated and raked to a smooth outline.
 12. Shrubs and groundcovers shall be installed in relation to walks and paving to allow for future growth without obstructing traffic with clearance as shown on the drawings.
 13. All plants shall be set in watering basin which shall be as wide as the planting pit, but at least four feet (4') in diameter and four inches (4") deep for trees and two feet (2') in diameter and three inches (3") deep for shrubs and vines.
 14. Ground cover plants shall be planted at the spacing noted on the drawings. Not more than fifteen minutes shall elapse from the time any groundcover plant is planted until it is watered.
- C. Pruning: Prune plants in accordance with established horticultural practice. Shearing of any plants will not be acceptable. Tree pruning shall only be performed with the written approval of the Landscape Architect and under the direction of a certified arborist, and shall comply with ISA Pruning Standards (ANSI 300).

3.8 MULCH

- A. Prior to any mulch application, perform weed control operations as specified herein.
- B. Where mulch is to be installed in an existing planting area, breakup/till the existing soil in open areas around existing plantings to a minimum 4" depth per section 3.02, and adjust finish grade adjacent to hardscape elements per section 3.05 where not prohibited by existing plantings.

- C. Install a minimum 3" layer of mulch in all non-turf planting areas, except for slopes greater than 3h:1v and seeded areas. Install a minimum 2" layer of mulch in all areas receiving flatted plants.
- D. Install a minimum 3" layer of wood mulch at a minimum 3' radius from the tree trunk of all trees located in turfgrass areas. Provide a smooth finish grade transition to a 2 inch depth where the mulch meets the turfgrass, so that the top elevation of the mulch is flush to the turfgrass soil. Keep mulch off the trunk. For new trees in turfgrass areas, remove the watering berm just prior to the turfgrass planting but maintain the mulched area within the planting pit.

3.9 STAKING & GUYING

- A. Trees shall be supported by two (2) tree stakes as shown on the drawings. Cut off the top of stakes damaged by installation or where the stake conflicts with canopy branches.
- B. Stakes shall be set firmly in the ground outside the rootball and where possible set stakes perpendicular to the prevailing northwest wind.
- C. Trees shall be tied to upright stakes loosely with tree ties (see planting detail). Remove the nursery stake.
- D. Multi-trunked trees shall be guyed, or individual branches may be staked and loosely tied as shown on the Drawings.

3.10 ROOT BARRIER

- A. Install root barrier along hardscape edges whenever the distance from the center of the trunk to the hardscape edge is less than eight (8) feet. Install per the planting details and manufacturers recommendations.

3.11 ARBOR GUARD

- A. Install ArborGard+ on all newly planted tree trunks in turfgrass areas per manufacturer's recommendations.

3.12 TURFGRASS SOD

- A. The area to be planted shall be finish graded to present a smooth and even surface free of humps and hollows and conforming to the finish grading plans. Where new sod is abutting existing turfgrass, fine grade to allow for the thickness of the new sod soil so that the new and existing sod grades are flush. Immediately prior to planting, the surface of the area to be planted shall be sufficiently loose and friable, with adequate moisture to receive the sod. Avoid laying sod on hot or dry soil.
- B. Lay first strip of sod slabs along a straight line (use a string in irregular areas). Butt joints tightly. Do not overlap edges. On second strip, stagger head joints (similar to a running bond brick pattern). Use a sharp knife to cut sod in order to fit curves, edges, and sprinkler heads.
- C. Install with turf-tired machinery full width sections sod as delivered and flush to adjacent surfaces. Terminating sod edges shall be straight and at right angles to hardscape elements whenever possible.
- D. As the sod is being installed, water the sod lightly to prevent drying out. Continue to lay sod and lightly water until installation is complete.

- E. After laying sod, roll to eliminate irregularities and to form good contact between sod and soil. Avoid a too heavy roller or excessive initial watering which may cause roller marks.
- F. Water the completed lawn surface thoroughly. Topsoil should be constantly moist for a minimum two inches deep. Repeat irrigating at regular intervals to keep sod moist until rooted. The areas shall not be watered to the extent of saturating the soil and causing "flotation" or "flowing" of the top surface of the soil. After water has once been applied, no portion of the planted areas shall be allowed to dry out during the entire maintenance period. After sod roots are established, decrease frequency and increase amount of water per application as necessary to maintain good soil moisture to a minimum 6" depth without standing water or excess runoff. The Contractor shall be responsible to monitor the site and alter the watering times and frequencies to meet site and climatic conditions.
- G. Prior to the start of the maintenance period, fill all seam joint gaps greater than 1/8 inch and less than 0.5 inch with washed concrete sand. Fill any joint gaps of 0.5 inch or greater width with a minimum two foot long replacement sod section in order to achieve a tight joint.
- H. Replace dead or distressed sod with equivalent material as directed by the Landscape Architect.
- I. Do not install turfgrass inside the watering basin of new trees planted in turf areas, or within a 3' radius of existing tree trunks located in turf areas.

3.13 CLEAN-UP AND REPAIR

- A. All areas shall be maintained in a neat and orderly condition at all times. All reasonable precautions shall be taken to avoid damage to existing planting and structures. Disturbed and/or damaged areas, whether a part of this work or from the work of other trades, shall be restored to their original condition.
- B. Plants and/or turfgrass shown to remain and damaged or removed by construction operations and/or utility/electrical/drainage lines shall be replaced with plants that match as closely as possible to the existing plant species, variety and size. The replacement turfgrass sod variety shall be the same as shown in the Planting Legend if for new work, or shall match the existing turfgrass variety where the turfgrass is existing. Adjust the finish grade so that the new turfgrass sod abuts flush to the existing turfgrass or to hardscape. The replacement plants and/or turfgrass sod shall be maintained as part of the original scope of work.
- C. After the planting operations are completed, the Contractor shall remove all trash, excess soil, empty containers or any other debris accumulated by the work from the site. All damage caused by the work shall be repaired at the Contractor's expense and the site shall be left in a neat and orderly condition to the satisfaction of the Owner.

3.14 PRE-MAINTENANCE REVIEW

- A. A general review will be held prior to the start of the maintenance period upon conclusion of the planting operations, irrigation system installation and after clean-up has occurred. The Owner's Representative shall be informed in writing a minimum of seven (7) working days prior to the time the work is ready for review in order to arrange a suitable time and date for such review.
- B. At the time of review, Contractor shall have all planting areas free of weeds and neatly cultivated and fine graded. All plant basins shall be in good repair. All trees shall be properly staked and tied. All planting areas shall be clear of weeds.

- C. The establishment of turfgrass is herein defined as being all work necessary to grow a full, healthy, uniform stand of smooth and even texture and grade with clean straight edges without weeds, distressed areas or bare spots, and has been mowed at least twice per the specifications. The establishment of turfgrass is further defined as being all work necessary to develop a minimum rooting depth of 2 inches into site soil.
- D. Work requiring corrective action or replacement in the judgment of the Owner's Representative shall be performed within five (5) days after the inspection. Corrective work and materials replacement shall be in accordance with the drawings and specifications and shall be made by the Contractor at no cost to the Owner. A subsequent review shall then be arranged.
- E. If after the review, the Landscape Architect is of the opinion that all the work has been performed as per the Contract Documents, and a uniform stand of healthy dense turfgrass has been established without weeds or bare spots, the Contractor will be given written notice that the maintenance period may begin.

3.15 MAINTENANCE - GENERAL

- A. After all work indicated on the drawings or herein specified has been completed, reviewed, and approved, and the turfgrass has been successfully established per the requirements below, the Contractor shall commence a sixty (60) calendar day maintenance period in which the Contractor shall continuously maintain all areas included in the contract during the progress of the work and throughout the maintenance period, or until Final Acceptance of the project, whichever is greater.
- B. Establishment and maintenance work includes monitoring the site to control all watering, replanting, fertilizing, mulching, weeding, cultivating and mowing necessary to bring the planted areas to a healthy and vigorous growing condition, and any additional work needed to keep the areas neat, edged, weed and trash free, and attractive.
- C. All trees, shrubs, ground cover shall be kept at optimum growing condition by watering, weeding, replanting, fertilizing, cultivating, tree stake repair, spraying for diseases and insects, replace dead or dying materials, pruning as directed, maintaining proper grades of plants, and providing any other reasonable operations of maintenance and protection required for successful completion of the project.
- D. Any date when the Contractor fails to adequately water, replace unsuitable planted areas and other work determined to be necessary by the Owner, will **NOT** be credited as part of the establishment/maintenance period.
- E. No additional payment will be made for additional time necessary for turfgrass establishment. The maintenance period shall not start until all contract work has been completed and all close-out documents and materials have been submitted. Turfgrass will be considered weed-free if there is a maximum of one percent undesirable turfgrass species, and nine weeds or less per 50 square yards (one per 50 square feet).
- F. During the progress of the maintenance period, the Contractor and the Owner's Representative shall conduct reviews at no less than 21 day intervals to determine that ongoing maintenance activities have been conducted by the Contractor. If in the opinion of the Owner, ongoing maintenance has not been conducted by the Contractor in a satisfactory manner the maintenance period shall be suspended. The Contractor shall provide remedial work as directed by the Owner's Representative to correct the found deficiencies and schedule another review. If after the subsequent review the work is deemed acceptable, the maintenance period shall resume.

3.16 MAINTENANCE – MOWING AND DRESSING

- A. The first two mowings of warm-season Bermudagrass varieties grown from seed/stolons shall commence when the grass is two (2) inches tall and cut down to one and one-half (1.5) inch. Mowing height for the second two mowings shall be when 1.75 inch tall and cut down to 1.25 inch. The next two mowing shall be when 1.4 inch tall and cut down to 1.0 inch. For all subsequent mowing and for new sod, mow when 1.125 inch tall and cut down to 0.75 inch.
- B. The first two mowings of warm-season Bermudagrass varieties grown from seed/stolons shall commence when the grass is two (2) inches tall and cut down to one and one-half (1.5) inch. Mowing height for the second two mowings shall be when 1.75 inch tall and cut down to 1.25 inch. For all subsequent mowing and for new sod, mow when 1.4 inch tall and cut down to 1.0 inch.
- C. The first three mowings of Tall Fescue cool-season grass varieties shall commence when the grass is three and one-half (3.5) inches tall and cut down to three (3.0) inches. For all subsequent mowings, mow when 3.25 inches tall and cut down to 2.5 inches.
- D. The first three mowings of temporary or overseeded cool-season grass varieties shall commence when the grass is two and one-half (2.5) inches tall and cut down to one and three quarters (1.75) inches. For all subsequent mowings, mow when the grass is 2.25 inches tall and cut down to one and one-half (1.5) inch.
- E. Turfgrass areas shall be mowed during the growing season a minimum of twice a week for warm-season varieties and a minimum of once a week for cool-season varieties, or at any time the grass reaches 1.4 times its mowing height. Turfgrass shall be edged weekly. The Contractor shall coordinate his watering and weed control schedules to accommodate his mowing schedule. If the Contractor is unable to mow the turf areas on the required day, he has until 5:00 pm of the next day to do the work. After that time, the Owner reserves the right to secure the services of an alternate mowing entity to perform the work. The cost for the alternate mowing will be deducted from monies owed to the Contractor. The Contractor will remain responsible to perform all scheduled mowings and maintenance of the site. The turfgrass shall be mowed and edged, and all trash and debris removed prior to Final Acceptance.
- F. Thirty days after the start of the maintenance period, team sports fields shall be topdressed and dragged with USGA topdressing sand at a rate of 1.15 tons per 1,000 square feet (+0.25 inch depth). Drag and roll all topdressed turfgrass areas with a lightly weighted turf roller in order to provide a smooth and even mowing surface. Additional topdressing may be required later in the maintenance period if the finish grade planarity is not acceptable.

3.17 MAINTENANCE - FERTILIZATION

- A. The Contractor shall fertilize the warm-season turfgrass (Bermudagrass) at the start of the maintenance period and every twenty-eight (28) days with the turfgrass maintenance fertilizer at a rate of 1.5 lb. of actual N, and/or P and/or K /1,000 s.f. and as modified by the soil fertility recommendations and as directed by the Landscape Architect. The Contractor shall allow for at least two separate fertilizer formulation applications in each fertilization operation. The Contractor shall continue the fertilizer applications until the established turf is accepted.
- B. The Contractor shall fertilize the turfgrass areas during the last week of the maintenance period with the turfgrass maintenance slow-release N fertilizer (43-0-0) at a rate of three and one-half (3.5) lbs./1,000 s.f. and as modified by the soil fertility recommendations and as directed by the Landscape Architect. The Contractor shall allow for at least two separate

fertilizer formulation applications in each fertilization operation.

- C. The Contractor shall fertilize the non-turf planted areas during the last week of the maintenance period with the mixed pre-planting fertilizer (14-6-11.6) at a rate of six (6.0) lbs./1,000 s.f. and as modified by the soil fertility recommendations and approved by the Landscape Architect. The Contractor shall allow for at least two separate fertilizer formulation applications in each fertilization operation.

3.18 MAINTENANCE – REPAIR AND WEEDING

- A. Between the twenty-first (21) day and the twenty-eighth (28) day after turfgrass planting, the Contractor shall perform the following: replant all spots or areas where normal germination or growth is not evident; remove all rocks or other debris that would constitute a hindrance to mowing or cultivating; repair all damage done by his operations. Where poorly compacted trench backfill shows settlement, remove turfgrass or plants, fill all depressions and eroded channels with sufficient conditioned topsoil to raise to proper grade, compact lightly and replant the filled areas. Roll all planted or replanted turfgrass areas with a lightly weighted turf roller in order to provide a smooth and even mowing surface.
- B. Visible weeds shall be removed at least weekly during the maintenance period. At the end of the maintenance period, all planting areas shall be without weeds. If weeds are present, the Contractor shall manually remove the weeds and shall then apply a granular, selective pre-emergent herbicide at manufacturer's approved rates. Coordinate application with the Owner's Representative and provide certificates of application to Owner's Representative. The turfgrass will be considered weed-free if there are 9 weeds or less per 50 square yards (one per 50 square feet).

3.19 FINAL REVIEW

- A. A Final Review will not be scheduled until all Close-out Documents and materials have been submitted and accepted.
- B. A Final Review will be performed before the end of the Maintenance Period or upon the pending Final Acceptance of the work, whichever is earlier, provided all deficiencies revealed during the maintenance period have been corrected. If deficiencies have not been corrected by the end of the stated maintenance period, the Contractor shall continue to fully maintain the project at his own expense. After all deficiencies have been corrected, a Final Review will be held with the Landscape Architect, Owner's Representative, and Contractor.
- C. Final Acceptance of turfgrass is contingent on a weed free, healthy uniform stand without dead, bare or distressed areas with a minimum rooting depth of five (5) inches into site soil.
- D. If after the Final Review, the Landscape Architect and Owner's Representative are of the opinion that the work is acceptable and complete, the Contractor's maintenance responsibility shall terminate on an agreed upon date.

3.20 WARRANTY AND REPLACEMENT

- A. All trees and plants provided under this Contract shall be guaranteed to be in good, healthy, disease/pest free and in a flourishing condition one growing year from the date of Final Acceptance of the work, provided the Owner maintains the plants properly and in accordance with accepted horticultural practices. Species and size of any tree and/or plant replacements, either prior to or after Final Acceptance, shall be equal to that of the same adjacent trees and/or plants at the time of replacement as determined by the Landscape Architect.

- B. The Contractor shall be responsible to replace all lost plants due to theft, vandalism or any other preventable causes till Final Acceptance of the work by the Owner. Replacement trees and plants shall be planted as originally specified and detailed. Replacement trees and plants shall be guaranteed as specified above from the date of replacement. The maintenance period may be extended for a duration of not more than the original maintenance period duration for the establishment of replacement plants.
- C. The Contractor shall be held responsible for repair and/or replacement of damages to new or existing improvements resulting from the defects or actions of trees, plants, materials, equipment or workmanship one year from the date of Final Acceptance or the Notice of Completion, whichever is later.

END OF SECTION

SECTION 331200
WATER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:

- 1. Pipe and fittings for on-site domestic piping.
- 2. Valves and valve boxes.
- 3. Accessories.

- B. RELATED SECTIONS

- 1. Contract General Conditions and Division 1, General Requirements.
- 2. Section 311100 - Site Clearing
- 3. Section 312000 - Earthwork: Excavation, Filling and Grading
- 4. Section 312222 - Soil Materials
- 5. Section 312333 - Trench Excavation and Backfill.
- 6. Section 321313 - Site Concrete Improvements.

1.3 REFERENCES

- A. ASTM Test Method D1557 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18-inch (457 mm) Drop.
- B. ANSI/ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
- C. ANSI/AWWA C110 - Ductile Iron and Grey-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids.
- D. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- E. ANSI/AWWA C500 - Gate Valves, 3-inch through 48-inch NPS, for Water and Sewage Systems.
- F. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water.
- G. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and Class 200.

- H. ASTM D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
- I. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

1.4 SUBMITTALS

- A. Submit in accordance with Specification Section SUBMITTALS and the Contract General Conditions.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Contract General Conditions and Division 1 Specifications.
- B. Accurately record actual locations of piping mains, valves, connections and appurtenances, referenced to permanent surface features.
- C. Identify and describe discovery of uncharted utilities or utilities found at locations different than indicated on plans.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with product manufacturer's recommendations and these Contract Documents.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle all products required.

PART 2 - PRODUCTS

2.1 WATER PIPE

- A. Ductile Iron Pipe (for iron pipe larger than 3 inches in diameter, above ground): ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, thickness Class 50, with cement - mortar lining and seal coating per ANSI/AWWA C104/A21.4.
 - 1. Fittings: ANSI/AWWA C110/A21.10, ductile iron.
 - 2. Joints: Flanged.
- B. PVC Pipe (for pipe 3 inches and smaller, underground): ASTM D1785, Schedule 40.

1. Fittings: ASTM D 2464, Schedule 80 PVC (ASTM D 2466, Schedule 40 PVC for pipes 1-1/2 inches and smaller).
 2. Joints: ASTM D 2855, solvent weld.
- C. PVC Pipe (for pipe 4 inches and larger, underground): ANSI/AWWA C900 Class 305.
1. Fittings: ANSI/AWWA C111, ductile iron.
 2. Joints: ASTM D 3139 compression gasket ring.
- D. Locator Tape: Tape shall be an inert material such as polyethylene plastic with a metallic core, and highly resistant to alkalis, acids, or other chemical components likely to be encountered in soils. The tape shall be bright colors for contrast with the soils with identifying print in black letters. The tape shall be six inches wide and be printed "CAUTION - WATER LINE BELOW".

2.2 VALVES - UP TO 2 INCHES (50 MM)

- A. Use full port ball valves for 2 inches and smaller and resilient wedge gate valves for 2-1/2 inches and larger size.
- B. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends.

2.3 GATE VALVES - 2-1/2 INCHES (63 MM) AND OVER

- A. ANSI/AWWA C509, Iron body, bronze trim, non-rising stem with square nut or control handle wheel, resilient single wedge, threaded or flanged.

2.4 VALVE BOXES

- A. Precast concrete with cast iron lid marked for service. Christy No. G5 or approved equal.
- B. Valve boxes shall have a minimum 6 inch wide by 4 inch (6" inches in vehicular areas) thick concrete collar.

2.5 ACCESSORIES

- A. Concrete for Thrust Blocks and Valve Box Surface Collars: Concrete type specified in Specification Section SITE CONCRETE IMPROVEMENTS.
- B. Valve Boxes and Covers: Christy No. G5 traffic box, or approved equal. Cover marking shall read "Water". A one-piece PVC riser extension shall be provided as necessary to allow unobstructed access to valve operating nut.
- C. Solvent Cement and Primer for PVC Pipe and Fittings: Per ASTM F656 and ASTM D2564.
- D. Non-Firming Anticorrosion Wrap: Trenton Wax-Tape #1 or approved equal for application on belowground metal surfaces, pipe, or fittings in corrosive soils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions. All plot dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and report any variations to the Engineer.
- B. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, etc., which may be required. Carefully investigate the structural and finished conditions affecting all work, and plan work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Unless dimensions are shown, drawings are generally diagrammatic and indicative of the work to be installed in the most direct and workmanlike manner, so that conflicts between water systems, planting, and architectural features will be minimized.
- C. Do not install the facilities as indicated on the drawings when it is obvious in the field that unknown obstructions might not have been considered in the engineering. Such obstructions or differences should be brought to the attention of the Engineer before proceeding.

3.2 PREPARATION

- A. Prepare for pipe installation by assembling all needed materials.
- B. Cover all PVC pipe during storage.

3.3 BEDDING

- A. Excavate trench, pit or hole in accordance with Specification Section TRENCH EXCAVATION AND BACKFILL.
- B. Where trench or pit has been overexcavated, place bedding material at bottom of excavations, level soil materials in continuous layers not exceeding 8-inches loose uncompacted depth.
- C. Backfill around sides and to a level 12-inches above the top of pipe with bedding sand, tamped in place.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE AND FITTINGS

- A. Install pipe at locations and depths indicated on plans.
- B. Install pipe, fittings, and associated materials in accordance with manufacturer's recommendations.
- C. Route pipe in straight line, whenever possible. All changes in direction of pipes shall be made with fittings, not by bending.

- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Form and place concrete for thrust blocks at each elbow, tee, angle or other significant change of direction in loose-joint pipe, per detail on plans.
- F. Establish elevations of buried piping to ensure not less than 30-inches of cover, except at connections to existing lines, which may be shallower or deeper, or where shown otherwise on plans.
- G. When two water pipes are to be installed in same trench, maintain a minimum 4-inch horizontal clearance between pipes.
- H. Backfill trench or other excavation in accordance with Specification Section TRENCH EXCAVATION AND BACKFILL.

3.5 INSTALLATION - VALVES

- A. Set valves on solid bearing.
- B. Where valves are installed below finish surface grade, center and plumb valve box and any necessary extensions over valve. Set box cover flush with finished grade.
- C. Pour concrete collar around top of valve box per detail on plans.
- D. Furnish and install valves and valve boxes in addition to those shown on plans as required for isolation of lines for construction and disinfection, while minimizing disruption of service to buildings, at no additional cost to the Owner.

3.6 INSTALLATION - THREADED CONNECTIONS

- A. Assemble all plastic and galvanized steel threaded pipe and fittings using an approved Teflon tape applied to the male threads only. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved Teflon tape will be required.
- B. At all plastic (PVC) pipe connections, work the ductile iron connections first. Connections shall always be plastic into steel, never steel into plastic.
- C. A non-hardening sealant and lubricant similar to Permatex #51 or LASCO blue pipe sealant may be used in lieu of Teflon tape. Apply sealant to clean male threads brushing into grooves and to the first three threads of the female threads.

3.7 PRESSURE TESTING OF SITE WATER PIPING SYSTEM

- A. General: Unless otherwise directed, tests shall be witnessed by Inspector. Work to be concealed shall not be covered until prescribed tests are made. Should any work be covered before such tests, the Contractor shall, at his expense, uncover, test and repair his work and that of other contractors to original conditions. Leaks and defects shown by tests shall be repaired and entire work re-tested. Tests may be made in sections, however, all connections between sections previously tested and new section must be included in the test.

- B. Water Piping: Pressure test all onsite water piping systems in accordance with AWWA Standard C605, "Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings". The pressure testing process shall be performed in cooperation with the authority having jurisdiction and witnessed by the Owner's Inspector. The constructor shall supply an affidavit of compliance to the Owner as required by AWWA Standard 605. Maintain 150 PSIG water pressure for a duration of four (4) hours. There shall be no drop in pressure during test except that due to ambient temperature changes. Flush all lines prior to pressure test.
- C. Backflow Preventer: All backflow preventers shall be tested according to manufacturer's recommendations and the USC Cross Connection Control and Hydraulic Research Manual latest edition and per local AHJ requirements. Testing shall be performed by an AWWA Certified Backflow Prevention Assembly Tester. Contractor shall provide written certification to the Architect showing the date in which the backflow preventers were tested and confirmation that unit passed all test requirements.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect all domestic water piping systems in accordance with AWWA Standard C651, "Disinfecting Water Mains", and in accordance with administrative authority. Disinfection process shall be performed in cooperation with health department having jurisdiction and witnessed by the Owner's Inspector. During procedure, signs shall be posted at each water outlet stating, "Chlorination - Do Not Drink". After disinfection, water samples shall be collected for bacteriological analysis. Certificate of Bacteriological Purity shall be obtained and delivered to the Owner by the Owner's Inspector.

3.9 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of the Contract General Conditions and Division 1 Specifications.
- B. Compaction testing of bedding and backfill will be performed in accordance with ANSI/ASTM D1557.
- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest. Any retests required due to failure of initial tests shall be paid for by the Contractor.

END OF SECTION

SECTION 333000
SITE SEWER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:
 - 1. Sanitary Sewer Pipelines and Fittings.
 - 2. Accessories.
- B. RELATED SECTIONS
 - 1. Contract General Conditions and Division 1, General Requirements.
 - 2. Section 311100 - Site Clearing
 - 3. Section 312000 - Earthwork: Excavation, Filling and Grading
 - 4. Section 312222 - Soil Materials
 - 5. Section 312333 - Trench Excavation and Backfill.
 - 6. Section 321313 - Site Concrete Improvements.

1.3 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies
 - 1. Safety Regulations: Work shall comply with all Federal, State and Municipal regulations regarding safety, including the requirements of the following:
 - a. William-Steiger Occupational Safety & Health Act of 1970.
 - b. State of California, California Administrative Code, Title 8 Industrial Relations, Chapter 4, Subchapter 4, "Construction of Safety Orders" and other State and local agencies having jurisdiction.
 - c. All trenching work shall conform to Trench Construction Safety Orders of California State Industrial Accident Commission.

1.4 REFERENCES

- A. American Water Works Association (AWWA).
- B. American Society for Testing and Materials (ASTM):
 - 1. Designation D3034 - Polyvinyl Chloride (PVC) pipe.
- C. California Plumbing Code, Latest Edition (CPC).

- D. Local County Health Department Standards.

1.5 SUBMITTALS

- A. Submit under provisions of Specification Section - SUBMITTAL PROCEDURES. Certificates of compliance for material
- B. Product Data: Provide data indicating pipe, accessories, and associated equipment to be furnished.
- C. Submit manufacturer's data and/or fabrication drawings for Sanitary Sewer Pipelines, Sanitary Sewer Manholes and Sanitary Sewer Fittings, installed under this Section. No items shall be incorporated into the work until submittals are approved by the Engineer.

1.6 COORDINATION

- A. Verify location of existing utilities have been indicated at by local utility authorities.

1.7 EXISTING UTILITIES

- A. The Engineer has made a diligent attempt to indicate on the plans the location of all main and trunkline utility facilities which may affect the Work. In most cases, however, the only available information relative to the existing location of said facilities was small scale undimensioned plats. The location of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- B. Service laterals and appurtenances have also been shown where information was available as to their location. In most cases, however, the only available information relative to the existing location of said facilities was small scale undimensioned plats. The location of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. At new work location, expose by hand methods all existing utilities along the route of the new work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand methods to locate all existing facilities as indicated on the plans, and as indicated at the work site by local utility authorities.
- D. Maintain all existing utility mains and service lines in constant service during construction of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sanitary sewer pipelines for pipes 4 inches and larger shall be polyvinyl chloride (PVC) pipe conforming to ASTM Designation 3034, SDR-35, with elastomeric gasket joints per ASTM D 3212 and F477.

- B. Sanitary sewer pipelines for pipe less than 4 inches shall be Schedule 40 PVC pipe, ASTM D1785.
- C. All sanitary sewer fittings shall be watertight connections using PVC sewer fittings as approved by the California Plumbing Code, or approved equal to be determined by the Civil Engineer.
- D. Surface cleanout shall be precast concrete with cast iron lid marked for service Christy G5 or approved equal and constructed as per detail drawing and current plumbing code.
- E. Locator Tape: Tape shall be an inert material such as polyethylene plastic with a metallic core, and highly resistant to alkalis, acids, or other chemical components likely to be encountered in soils. The tape shall be bright colors for contrast with the soils with identifying print in black letters. The tape shall be six inches wide and be printed "CAUTION - SEWER LINE BELOW".

PART 3 - EXECUTION

3.1 CLEARING OF WORK SITE FOR SITE IMPROVEMENTS

- A. Clear site for improvements per construction drawing demolition plan and in accordance with Specification Section SITE CLEARING.

3.2 TRENCH EXCAVATION

- A. Trench excavation and backfilling shall be in accordance with Specification Section TRENCH EXCAVATION AND BACKFILL and construction drawing detail.
- B. Excavate trench to depth which is 6 inches below the outside bottom of the pipe barrel to be placed therein.

3.3 PIPE BEDDING MATERIAL

- A. Excavated materials and imported materials shall meet engineering recommendations in accordance with Specification Section SOIL MATERIALS.
- B. Bed pipe in sandfill and compact to a minimum of 90% relative compaction. Place and compact the bedding material under, around and over the pipe, filling the trench cavity and extending from the bottom of the trench (6 inches below the outside bottom of the pipe barrel) to a level 12 inches above the outside top of the pipe barrel

3.4 PIPE INSTALLATION

- A. Pipe Laying: Alignment and elevation stakes shall be set at intervals with offsets and cut to the invert of the pipe.
 - 1. Proper facilities shall be provided for stringing and lowering sections of pipe into the trench. The pipe shall be laid carefully to lines and grades given.

2. The grade line shown on the plans indicates the flow line or invert of the pipe and all cuts, unless otherwise indicated, refer to this line.
 3. After the trench for pipe has been brought to the proper line and grade, the pipe shall be laid in the following manner.
 - a. Pipe laying shall proceed upgrade with the bell ends of bell and spigot pipe placed upstream. Each section of pipe shall be laid to line and grade as herein specified and in such a manner as to form a watertight, concentric joint with the adjoining pipe. The interior of the pipe shall be cleared of all dirt and debris and excess joint sealing material as the work progresses. Pipe shall not be laid when the condition of the trench or weather is unsuitable. All open ends of pipe and fittings shall be adequately and securely closed whenever the work is discontinued for more than one-half hour. If pipe with elliptical or quadrant reinforcement is used, care shall be taken to properly orient the axis.
 4. All joint surfaces shall be cleaned before joints are made.
 5. The Contractor shall furnish and use, for grade and alignment control, a laser beam system which complies with OSHA requirements. The laser system shall have good visibility when used with suitable target material. The laser system must be of the self-leveling type so that the laser beam is automatically compensated for minute grade disturbances.
 6. The laser system must also have an early warning system that instantly warns the pipe layer when the laser is off grade. The laser system is to be provided by the Contractor and shall have a minimum accuracy of ± 0.01 foot per one hundred feet (100') on line; and a minimum visible range of one thousand feet (1000'). When conditions are such that this method is impractical, such as on short pipe runs, the Contractor shall have an Engineer on the ground to set grade of each joint of pipe by means of an Engineer's level.
- B. Sewer Systems Plugs: Temporary plugs of brick or mortar shall be installed on all sewer projects at points of connection to existing facilities. These plugs shall remain in place until completion of the balling and flushing operation. The plugs, intended to prevent water from the balling and flushing operation, drainage, or any other condition from entering the existing system, shall be installed or removed in the presence of and under the direct supervision of the Engineer. Until the system has been pumped clear of accumulated water, the plugs shall not be removed. This water must not be allowed to enter adjacent sewer or drainage systems.
- C. Internal Inspection: Upon completion of construction and prior to final inspection, the Contractor shall clean the entire new pipeline of all dirt and debris. Any dirt or debris in previously existing pipes or ditches in the area, which in the opinion of the Engineer resulted from the new installation, shall also be removed by the Contractor. Sewer pipes shall be cleaned by the controlled balling method. Temporary plugs shall be installed and maintained during cleaning operations at points of connection to existing facilities to prevent water, dirt, and debris from entering the existing facility. Temporary plugs for sewer systems shall also conform to Subsection B, above. Water from the drainage system operations shall be routed through a suitable trap to collect any dirt and debris prior to discharging into any downstream facility. The Contractor shall notify the Architect immediately after completion of the pipe cleaning operations. Cleaning of drainage pipes by the controlled balling method will not be required.

- D. As soon as possible after the completion of the pipe cleaning, and prior to final acceptance, the Architect or Engineer may make a visual internal inspection of the new pipeline either manually or with television equipment.

3.5 COORDINATION

- A. Coordinate with the campus for the shutdown of the existing sewer system to make new sewer connection. Install sewer pipelines before making tie-in to the existing sewer pipeline. Tie-in work may proceed during the campus non-use of the existing sewer system such as on weekends.

3.6 TESTING OF SANITARY SEWERS

- A. After cleaning per Section 3.4-C, each section of sewer constructed shall be tested in accordance with acceptable "Low Pressure Air Test for Sanitary Sewers" methods such as presented in the Journal of Sanitary Engineering, Division ASCE, April 1964, to test the point of effluent disposal. All lines and components shall be leak proof.

3.7 INSPECTION OF SANITARY SEWERS

- A. System components shall be properly identified as to the manufacturer.

3.8 CLEAN-UP

- A. Remove from the site all rubbish, debris, etc. in a lawful manner, resulting from work in this Section. The clean-up shall include the replacement and repair of any damaged or disturbed property.

END OF SECTION

SECTION 334000
STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This section includes the following:
 - 1. Provide all materials, labor, equipment and services necessary to furnish and install Storm Drainage System, accessories and other related items necessary to complete the Project as indicated by the Contract Documents.
- B. RELATED SECTIONS:
 - 1. Contract General Conditions and Division 1, General Requirements.
 - 2. Section 312222 – Soil Materials
 - 3. Section 312333 – Trench Excavation and Backfilling.
 - 4. Section 321313 – Site Concrete Improvements.

1.3 REFERENCES

- A. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
- B. ANSI/ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- C. ANSI/ASTM C478 Precast Reinforced Concrete Manhole Sections.
- D. ASTM D1557

1.4 DEFINITIONS

- A. Bedding: Fill placed under, around, beside and directly over pipe, prior to subsequent backfill operations.
- B. Utility: Any buried or above ground pipe, conduit, cable, associate device or appurtenances, or substructure pertaining thereto.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01.

- B. Certificates of compliance for material.
- C. Product Data: Provide data indicating pipe, accessories, and associated equipment to be furnished.
- D. Submit manufacturer's data and/or fabrication drawings for all pipes, and appurtenances installed under this Section. No items shall be incorporated into the work until submittals are approved by the Architect/Engineer

1.6 COORDINATION

- A. Coordinate work with Owner's personnel.
- B. Verify that the location of existing utilities have been indicated at work site by utility authorities and Owner's personnel.
- C. Coordinate work with other project work.

1.7 EXISTING UTILITIES

- A. The Engineer has made a diligent attempt to indicate on the plans the location of all main and trunkline utility facilities which may affect the Work. In most cases, however, the only available information relative to the existing location of said facilities was small scale undimensioned plats. The location of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- B. Service laterals and appurtenances have also been shown where information was available as to their location. In most cases, however, the only available information relative to the existing location of said facilities was small scale undimensioned plats. The location of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. At new work location, expose by hand methods all existing utilities along the route of the new work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand methods to locate all existing facilities as indicated on the plans, and as indicated at the work site by Owner's personnel.
- D. Maintain all existing utility mains and service lines in constant service during construction of the Work

1.8 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01.
- B. Accurately record actual locations of utilities encountered.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforced Concrete Pipe for pipe larger than fifteen (15) inches: ANSI/ASTM C76, Class 3, with rubber gasket joints per ANSI/ASTM C443.
- B. Storm drainage sewer pipeline shall be polyvinyl chloride (PVC) pipe for storm sewer conforming to ASTM designation 3034, SDR 35, with elastomeric gasket joints per ASTM D 3212 for pipe fifteen (15) inches or less.
- C. Storm drainage pipeline shall be polyvinyl chloride (PVC) pipe for storm sewer conforming to ASTM D1785, Schedule 40, for pipe three (3) inches or less.
- D. Poured in Place Concrete: Specification Section SITE CONCRETE IMPROVEMENTS.
- E. Mortar: Composed of one part, by weight, portland cement (Type II low alkali per ASTM C150), 2 parts, by weight, sand, and water.
- F. Manhole Frames, Covers and Grates: Cast Iron per ASTM A48, Class 25.
- G. Soil Fill for Concrete Pipe Bedding Envelope: Specification Section TRENCH EXCAVATION AND BACKFILL.
- H. Catch basins and drain inlets shall be constructed as per detail drawing.
- I. Concrete collar shall be constructed as per detail drawing.
- J. Cleanout shall be precast concrete with cast iron lid marked for service Christy G5 or approved equal and constructed as per detail drawing.
- K. All metallic pipe, fittings and appurtenances in contact with soil shall be coated or wrapped with an approved material, as required to protect it from corrosive soil.
- L. Locator Tape: Tape shall be an inert material such as polyethylene plastic with a metallic core, and highly resistant to alkalis, acids, or other chemical components likely to be encountered in soils. The tape shall be bright colors for contrast with the soils with identifying print in black letters. The tape shall be six inches wide and be printed "CAUTION – STORM SEWER LINE BELOW".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.

3.2 PREPARATION

- A. Identify location of proposed storm drainage facilities to be constructed. Expose connection points to existing system.
- B. Locate, identify, and protect existing above and below grade utilities from damage.
- C. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.
- D. Protect existing structures and other improvements to remain from damage from excavation equipment and vehicular traffic.
- E. Employ equipment and methods appropriate to the work site.
- F. Protect excavated areas from drainage inflow, and provide drainage to all excavated areas. Dewater existing drainage basins and existing drainage pipeline systems as necessary to accomplish the work.
- G. Comply with safety requirements as they pertain to excavations, per Specification Section EARTHWORK.
- H. Remove all interfering surface and subsurface improvements authorized for removal.

3.3 EXCAVATION

- A. Excavate soil required to locate existing utilities and install the work.
- B. Excavate trenches and pits per Specification Section EARTHWORK.
- C. Excavate trenches and pits to allow installation and construction of the storm drainage facilities to the alignment, grades, depths and cross-sections as indicated on the construction plans.
- D. Excavate trench to depth which is 6 inches below the outside bottom of the pipe barrel to be placed therein.
- E. Cut trenches just wide enough to allow the installation of the pipe and pipe bedding as indicated on the plans. Minimize trench width above the pipe.
- F. Provide protection to public per Division 01.

3.4 INSTALLATION AND BEDDING OF STORM DRAIN PIPE

- A. Install the pipe and fittings to the lines and grades shown on the construction plans.
- B. Install pipe and fittings in accordance with the manufacturer's recommendations, and these specifications.
- C. Unless otherwise approved by the Engineer, lay all pipe upgrade from structure to structure, with bell or socket ends of pipe upgrade.

- D. Excavate suitable bell (or socket) holes in the bedding material, so that the bells do not bear on the subgrade or bedding. Provide uniform bearing of pipe barrel on bedding material.
- E. Ensure that all joints are properly "homed" and are watertight.
- F. Bed pipe in sandfill and compact to a minimum of 90% relative compaction. Place and compact the bedding material under, around and over the pipe, filling the trench cavity and extending from the bottom of the trench (6 inches below the outside bottom of the pipe barrel) to a level 12 inches above the outside top of the pipe barrel.

3.5 INSTALLATION OF STORM DRAINAGE STRUCTURES AND APPURTANCANCES

- A. Install storm drainage structures as indicated on the construction plans, in accordance with the manufacturer's recommendations, and as specified herein.
- B. Construct poured-in-place concrete per Specification Section SITE CONCRETE IMPROVEMENTS.
- C. Key top of poured-in-place concrete bases for structures to receive the tongue of precast riser sections.
- D. Construct cleanout, outfall structure per detail drawing.

3.6 BACKFILLING TO FINISHED GRADE AND FINISHED GRADING

- A. Place and compact backfill per Specification Section TRENCH EXCAVATION AND BACKFILL.
- B. Conform finished surface to the lines, grades and cross-sections shown on the plans, or as otherwise directed by the Inspector.
- C. In areas to receive paving or a significant thickness of sealing material, temporarily set manhole frame and cover below finish grade, then return after final surfacing and/or pavement sealing and bring manhole frame and cover to final grade, as shown on the plans.
- D. Fine grade all finished soil surfaces disturbed to the lines, grades and cross-sections shown on the plans.
- E. Rake and smooth all finished dirt surfaces.

3.7 TOLERANCES

- A. Pipe laying tolerances:
 - 1. Above grade: Not to exceed 1/4-inch above planned grade.
 - 2. Below grade: Not to exceed 1/2-inch below planned grade.
 - 3. Alignment: Not to exceed 2 inches from planned alignment, if gradual and regular over a distance of 20 feet.

- B. Structure finish grade tolerance: Within 1/4 inch of planned grade, but must match adjacent improvements.

3.8 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01.
- B. Compaction testing of bedding and backfill will be performed in accordance with ASTM D 1557.
- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest at no additional cost to Owner.

END OF SECTION

APPENDIX NO. 1



GEOTECHNICAL & ENVIRONMENTAL ENGINEERING — CONSTRUCTION TESTING & INSPECTION

June 12, 2024

TES No. 240282.001

Ms. Blanca Mercedes
Golden Plains Unified School District
22000 Nevada Street
San Joaquin, California 93660
Email: blancamercedes@massco.com

Project: Proposed Aquatic Complex Modernization
Tranquility High School
6052 Juancha Avenue
Tranquility, California

Subject: Geotechnical Investigation and Geologic-Seismic Hazards Evaluation Report

Dear Ms. Mercedes:

The enclosed report presents the results of a geotechnical investigation and geologic-seismic hazards evaluation for the proposed aquatic complex modernization to be constructed at the Tranquility High School in Tranquility, California. This report describes the investigation, findings, conclusions, and recommendations for use in project design and construction.

TECHNICON Engineering Services, Inc. (TECHNICON) appreciates the opportunity to provide geotechnical engineering services to Tranquility Community High School District during the design phase of this project. We trust this information meets your current needs. If there are any questions concerning the information presented in this report, please contact this office at your convenience.

Respectfully submitted,

TECHNICON Engineering Services, Inc.

Adam AhTye, PE
Senior Project Engineer

AA:SA:vm

Salvador Alvarez, PE, GE
Geotechnical Engineering Manager





**GEOTECHNICAL INVESTIGATION AND GEOLOGIC-
SEISMIC HAZARDS EVALUATION REPORT
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILITY, CALIFORNIA**

Prepared for:

Golden Plains Unified School District
22000 Nevada Street
San Joaquin, California 93660

June 12, 2024

TES No. 240282.001



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YEARS STRONG

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING - CONSTRUCTION TESTING & INSPECTION

Prepared For:

Golden Plains Unified School District
22000 Nevada Street
San Joaquin, California 93660

**GEOTECHNICAL INVESTIGATION AND GEOLOGIC-SEISMIC
HAZARDS EVALUATION REPORT
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILITY, CALIFORNIA**

**TECHNICON PROJECT
TES No. 240282.001**

Prepared by:

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June 12, 2024

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**GEOTECHNICAL INVESTIGATION AND GEOLOGIC-SEISMIC
HAZARDS EVALUATION REPORT
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILITY, CALIFORNIA**

1 INTRODUCTION

1.1 GENERAL

This report presents the results of a geotechnical investigation for the proposed aquatic complex modernization to be constructed at the Tranquility High School in Tranquility, California. The purpose of the investigation was to explore and evaluate the subsurface conditions at the site to develop geotechnical recommendations for project design and construction.

The Vicinity Map, presented on Figure 1, shows the general location of the project and the Site Map, presented on Figure 2, shows the proposed improvements and the boring locations for this investigation.

A geologic-seismic hazards evaluation was prepared concurrently with the geotechnical investigation and is incorporated into Sections 3 through 5 of this report. References reviewed during preparation of the geologic and seismic hazards section of this report are listed in Section 10, "References".

1.2 LOCATION

The project is located in eastern Fresno County, at 6052 Junache Avenue in Tranquility, California. Based on the Tranquility, California 7 ½-minute quadrangle topographic map, the site lies within the southeast quarter of Section 8, R16E and T15S. The elevation of the site is approximately 158 feet above the Mean Sea Level. Based on the USGS 7½-minute topographic map, the site coordinates are approximately:

Latitude: 36.6453° N
Longitude: 120.2529° W

1.3 PROPOSED CONSTRUCTION

It is understood that the project involves modernizing the two (2) existing pools at the aquatic center which consists of altering depths and dimensions, the design and construction of a new

2,880 square foot locker/restroom building, new bleachers, and a new parking lot. Preliminary planning of the pools includes raising the depth of the dive pool from 12 feet up to approximately 4 feet below the ground surface (bgs) and resizing the swim pool to accommodate more lanes. The new locker/restroom building is anticipated to consist of a single-story, wood-framed structure supported on shallow concrete foundations and a slab-on-grade floor. Maximum wall and column loads are estimated to be less than 3 kips per foot and 30 kips, respectively. Appurtenant improvements will include underground utilities, an asphalt concrete paved parking lot, concrete flatwork, and landscape. Cut and fill elevations are anticipated to be on the order of 8 feet.

1.4 PURPOSE AND SCOPE OF SERVICES

The purpose of the investigation and evaluation was to explore the site subsurface conditions and evaluate pertinent geologic and seismic data to develop recommendations and opinions to aid in project design, approval and construction. The scope of services consisted of a field exploration program, laboratory testing, design analysis, and preparation of this written report as described in **TECHNICON** proposal, dated April 30, 2024 (TES No. GP24-083). This Geotechnical Investigation and Geologic-Seismic Hazards Evaluation Report includes the following:

- ☐ A description of the proposed project, including a vicinity map showing the location of the site and a site plan showing the exploration locations;
- ☐ A description of the site surface and subsurface conditions encountered during the field investigation, including boring logs;
- ☐ A summary of the field exploration and laboratory testing program;
- ☐ Comments on regional and site engineering geology and seismology;
- ☐ Determination of peak horizontal ground surface acceleration utilizing the mapped spectral acceleration parameters of the 2022 California Building Code (CBC);
- ☐ Discussion of geologic hazards affecting the site and project, including liquefaction, seismically induced settlement, landslides, flooding, etc;
- ☐ Site preparation and earthwork, including the use of on-site soils for engineered fill and recommended import fill specifications;
- ☐ Spread footing design, including bearing capacity of foundation soil for sustained loading and total combined loading, embedment depths and anticipated total settlements;
- ☐ Resistance of lateral loads, including passive pressure and coefficient of friction;
- ☐ Design factors for earth retaining structures;

- ☐ Design of concrete slabs-on-grade for buildings, including modulus of subgrade reaction;
- ☐ Recommendations for asphalt concrete pavement design;
- ☐ Comments on the corrosion potential of on-site soil to buried metal and concrete;
- ☐ Comments to aid in the design of on-site drainage.

2 FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

The field exploration, conducted on May 15, 2024 consisted of drilling four (4) exploratory test borings, and a site reconnaissance by a staff engineer. The test borings were drilled with a SIMCO 2800 truck-mounted drill rig using 4-inch diameter solid flight auger drilling techniques and extended to depths of 16.5, 21.5, 26.5 and 51.5 feet below existing ground surface (bgs). Additionally, two (2) locations were drilled to a depth of 5 feet bgs for R-value sample collection. The approximate locations of the test borings and R-values are indicated on the Site Map, Figure 2.

The soils encountered in the borings were visually classified in the field and a continuous log was recorded. Relatively undisturbed samples were collected from the test borings at selected depths by driving a 2.5-inch I.D. split barrel sampler containing brass liners into the undisturbed soil with a 140-pound automatic hammer free falling a distance of 30 inches. In addition, samples of the subsurface soils were obtained using a 1.4-inch I.D. standard penetrometer, driven 18 inches in accordance with ASTM D1586 test procedures. The sampler was used without liners. Resistance to sampler penetration was noted as the number of blows per foot over the last 12 inches of sampler penetration on the boring logs. The blow counts listed in the boring logs have not been corrected for the effects of overburden pressure, rod length, sampler size, boring diameter, or hammer efficiency. Bulk samples were also retained from auger cuttings of the near surface soils at selected test boring locations.

2.2 FIELD AND LABORATORY TESTING

Penetration rates, determined in general accordance with ASTM D1586, were used to aid in evaluating the consistency, compression, and strength characteristics of the foundation soils.

Laboratory tests were performed on selected near surface samples to evaluate their physical characteristics. The following laboratory tests were used to develop the design geotechnical parameters:

- ☐ Unit weight (ASTM D2937)
- ☐ Moisture Content (ASTM D2216)
- ☐ Sieve Analysis (ASTM C136)

- ☐ Expansion Index (ASTM D3080)
- ☐ Direct Shear (ASTM D3080)
- ☐ Soluble Sulfate and Soluble Chloride Contents (California Test Method No. 417 & 422)
- ☐ pH and Minimum Resistivity (California Test Method No. 643)
- ☐ Consolidation Potential (ASTM D2435)
- ☐ Resistance Value (Caltrans Test Method No. 301)

The dry density and moisture content test results are shown on the boring logs in Appendix A. The soluble sulfate, soluble chloride, pH, and minimum resistivity are discussed in Section 7.7, "Corrosion Potential". The remaining test results are provided in Appendix B.

3 SITE AND GEOLOGIC CONDITIONS

3.1 REGIONAL GEOLOGY

The site lies within the central west portion of the San Joaquin Valley, within the Great Valley geomorphic province of California (CGS, 2002). The Central Valley is between the Sierra Nevada geomorphic province to the east, and the Coast Ranges geomorphic province to the west. The thick sequence of sediments that form the valley floor were eroded from these adjacent mountain regions and have been accumulating since the Jurassic period, about 160 million years.

The regional bedrock forms an asymmetrical trough, which is deepest near the western margin. The surficial sediments filling the trough include deposits of alluvial fans, flood plains, marshes, and lakes (Croft, 1972). The regional geologic map is presented on Figure 3.

3.2 AREA AND SITE GEOLOGY

The geology at the site is mapped as Quaternary recent aged Great Valley basin deposits (Qb), described sediments deposited during flood stages of major streams in the area between natural stream levees and fans. The soil subgrade characteristics encountered during the field investigation (i.e. soil type, blow count, etc.) are representative of these sediments. Figure 4 presents a site-specific geologic map of the project.

3.3 SURFACE CONDITIONS

At the time of investigation, the project site was occupied by the two (2) existing pools, pool house buildings, and landscaped grass areas. The site is generally bounded by the existing Tranquility High School to the north and west, Daniels Avenue to the east, and Randolph Avenue to the south. The overall site topography is relatively flat and at the same elevation as the surrounding grade.

3.4 EARTH MATERIALS

The subsurface soils consist of Quaternary recent aged Great Valley basin deposits (Qb). The earth material encountered by the subsurface exploration consisted of sandy clay in the upper 11 to 23 feet and underlain by laterally discontinuous layers of sandy clay, silty sand, and poorly graded sand with silt to the maximum depth explored, 51.5 feet bgs. The granular soils generally

had a relative density of medium dense and the fine grained soils had a consistency of stiff to very stiff.

The above is a general description of the earth material profile. A more detailed representation of the stratigraphy at the specific exploration locations is provided on the boring logs in Appendix A and the cross section on Figure 5.

3.5 GROUNDWATER CONDITIONS

Groundwater was encountered within boring B-3 to a depth of approximately 45 feet bgs. The California Department of Water Resources “Sustainable Groundwater Management Agency Data Viewer” Spring 2023, indicates the current groundwater depth in the area is on the order of 70 feet bgs. Research utilizing the California Department of Water Resources (DWR) website shows a nearby well with recorded data to be approximately 0.1 miles to the south (Well No. 15S16E08C001M). Based on the groundwater elevation data collected at this well, a historic high groundwater was measured for the area in 1959 at approximately 6.7 feet bgs.

Considering the measured groundwater, a design groundwater depth of 6.7 feet is recommended for project planning, design, and the evaluation of liquefaction and any seismically induced effects. This depth coincides with water elevations recorded in 1959.

Groundwater conditions at the site could change in the future due to variations in rainfall, groundwater withdrawal, construction activities, or other factors not apparent at the time our test borings were made. However, groundwater is not anticipated to impact construction.

4 FAULTING AND SEISMICITY

4.1 HISTORICAL SEISMICITY

The project site is in a region traditionally characterized by moderate seismic activity. Seismic activity of the site was researched using information obtained from the U.S. Geologic Survey (USGS) and California Geologic Survey (CGS) websites, a catalog by the Advanced National Seismic System (ANSS) and Caltrans Acceleration Response Spectra (ARS).

Some of the historical earthquake events that caused significant shaking at the site are listed in Table 4.1-1.

TABLE 4.1-1
SIGNIFICANT REGIONAL EARTHQUAKE EVENTS

Earthquake Name	Year	Distance from Site (km)	Magnitude (Mw)
Coalinga	1983	45	6.4
Great Fort Tejon	1857	68	7.9
Owens Valley	1872	190	6.5
Ridgecrest	2019	255	7.1

Epicenters of significant earthquakes ($M \geq 5.5$) within the vicinity of the site are shown on Figure 6. Data for earthquakes that occurred from 1800 to 2022 have been obtained from the Significant California Earthquakes website (CGS, 2019) and a composite catalog by the ANSS. The ANSS catalog is a worldwide earthquake catalog which is created by merging the master earthquake catalogs from contributing ANSS member networks and then removing duplicate events, or non-unique solutions from the same event. The ANSS network includes the Northern and Southern California Seismic Networks, the Pacific Northwest Seismic Network, the University of Nevada, Reno Seismic Network, the University of Utah Seismographic Stations, and the United States National Earthquake Information Service. The earthquake database also consists of earthquake records between 1800 and 1900 from Seeburger and Bolt (1976) and Topozada et al. (1978 and 1981).

4.2 FAULTS LOCAL TO THE PROPOSED SITE

The site is not located in an Alquist-Priolo Earthquake Fault Zone as established by the Alquist-Priolo Fault Zoning Act (Section 2622 of Chapter 7.5, Division 2 of the California Public Resources Code).

The CGS Fault Activity Map of California (2010) was reviewed to determine if identified active faults are located on or near the subject site. According to the map, no identified active faults are located on or near the subject site. Locations of active and late Quaternary faults in the area with respect to the subject site are shown on Figure 7, Regional Fault Activity Map (obtained from the Fault Activity Map of California, Jennings, Bryant and Saucedo, 2010).

Based on review of published data and current understanding of the geologic framework and tectonic setting of the proposed improvements, the primary sources of seismic shaking at this site are listed in Table 4.2-1. The table also provides the fault type, distance from the site, and maximum moment magnitude (M_w). A major seismic event on these or other nearby faults may cause ground shaking at the site. Based on the deterministic ground acceleration, the San Andreas Fault, located west of the site, is considered the governing fault.

**TABLE 4.2-1
PRIMARY SOURCES OF SEISMIC SHAKING**

Fault Name	Fault Type	Distance from Site (miles)	Magnitude (M_w)
Great Valley	Thrust	15	7.1
Ortogonalita	Right Lateral/ Strike Slip	36	6.7
San Andreas	Right Lateral/ Strike Slip	42	7.4
Quien Sabe	Right Lateral/ Strike Slip	54	6.4

4.3 SITE CLASS

Based on the field exploration, the site soil is classified as Site Class D as presented in ASCE 7-16 based on the average Standard Penetration Tests (N value) at the project site. Site Class D is defined as a stiff soil profile with shear wave velocities between 600 feet/sec and 1,200 feet/sec,

or Standard Penetration Resistance (N) between 15 to 50 blows/foot, or undrained shear strength (S_u) between 1,000 to 2,000 psf for the upper 100 feet.

4.4 GENERAL PROCEDURE SEISMIC DESIGN CRITERIA

In accordance with CBC 1613A.2 a general procedure ground motion analysis was performed. USGS seismic design mapped values were obtained for the project site utilizing a Site Class D, and site coordinates from the Structural Engineers Association of California (SEAOC) website (<http://seismicmaps.org>). The values obtained are provided in the table below.

TABLE 4.4-1
2022 CBC/ASCE 7-16 GENERAL PROCEDURE GROUND MOTION PARAMETERS

Seismic Item	Design Value	Seismic Item	Design Value
Site Class	D	Seismic Design Category	D
S_s	0.967	S_{MS}	1.076
S_1	0.336	S_{M1}	0.660
Site Coefficient, F_v	1.964*	S_{DS}	0.718
Site Coefficient, F_a	1.113	S_{D1}	0.440
T_s	0.613		

*This value of F_v should only be used for calculation of T_s . See Section 11.4.8 of ASCE 7-16

A probabilistic seismic hazards analysis (PSHA) procedure was performed using the USGS Unified Hazard Tool to estimate the earthquake magnitude. The program allows user input of the project site coordinates and produces the expected peak ground motions for selected probability of exceedance (e.g., return periods). Based on a probability of exceedance of 2 percent in 50 years, the USGS Unified Hazard Tool determined a peak ground acceleration of 0.528g and a weighted magnitude of $M_w = 6.28$.

4.5 SITE SPECIFIC SEISMIC DESIGN CRITERIA

In accordance with ASCE 7-16 11.4.8, since the project is in a site class D and the S_1 value is greater than 0.2 (0.336g) a site-specific ground motion hazard analysis was performed. The analysis followed the requirements of ASCE 7-16, Sections 21.2 through 21.5, as well as ASCE 7-16, Supplement No. 1 and No. 3, and 2022 CBC 1830A.6.

The following steps were utilized for determining the site-specific ground motion parameters: Seismic design parameters were obtained for the project site utilizing a Site Class D, and site coordinates from the Structural Engineers Association of California (SEAOC) website (<http://seismicmaps.org>). The USGS Unified Hazard Tool and the Risk-Targeted Ground Motion calculator was used to calculate the probabilistic ground motion response spectrum in accordance with ASCE 7-16 Section 21.2.1.2 Method 2. The 2014 NGA West2 – GMPEs worksheet from the Pacific Earthquake Engineering Research Center was then used to calculate deterministic spectral response acceleration as an 84th-percentile 5% damped spectral response acceleration in the maximum horizontal direction by using fault parameters and magnitude area relationships given by the USGS Unified Hazard Tool in accordance with ASCE 7-16 Section 21.2.2. Supplement No. 3 indicates that projects located in Site Class D should increase S_{M1} by 50 percent in Equation 11.4-2. This increase results in a 50 percent increase of S_{D1} in Equation 11.4-4. These increased values are to be used for all applications and formulation of the design response spectrum. The Site-Specific MCE_R was then calculated by a single factor such that the maximum response spectral acceleration equals $1.5F_a$, with F_a determined using Table 11.4.1 in the ASCE 7-16. In accordance with ASCE 7-16 Section 21.3, the design spectral response had to be checked that no period shall be taken as less than 80% of S_a determined in accordance with Section 11.4.6, where F_a is determined using Table 11.4.1 and F_v is taken as 2.4 for $S_1 < 0.2$ or 2.5 for $S_1 > \text{or equal to } 0.2$. After checking design spectrum is greater than 80% of code-based spectrum for all periods, using the design spectrum graph, design acceleration parameters such as S_{DS} is taken as 90% of max S_a between periods $T=0.2$ and 5 seconds and parameter S_{D1} taken as the maximum value of the product, TS_a , for periods from 1 to 5 seconds for sites with $V_s < 365.76$ m/s in accordance with ASCE 7-16 Section 21.4. The parameters S_{MS} and S_{M1} are then taken as 1.5 times S_{DS} and S_{D1} , respectively. Lastly, the maximum considered earthquake geometric mean peak ground acceleration is taken by comparing deterministic peak ground acceleration from 84th spectral acceleration at $T=0.01$ seconds to $0.5F_{PGA}$, following with the greater of those two values being compared to the probabilistic peak ground acceleration, with the lesser of the two values being the site-specific peak ground acceleration (0.528) in accordance with ASCE 7-16, Section 21.5. Based on this analysis, a peak ground acceleration of 0.528g is recommended for the evaluation of liquefaction. The site specific ground motion analysis is attached.

TABLE 4.5-1
2022 CBC/ASCE 7-16 SITE SPECIFIC GROUND MOTION PARAMETERS

Seismic Item	Design Value	Seismic Item	Design Value
Site Class	D	Seismic Design Category	D
S_s	0.967	S_{MS}	1.337
S_1	0.336	S_{M1}	1.008
Site Coefficient, F_v	2.500	S_{DS}	0.891
Site Coefficient, F_a	1.113	S_{D1}	0.672
T_s	1.170		

5 GEOLOGIC AND SEISMIC HAZARDS

5.1 GENERAL

A discussion of specific geologic hazards that could impact the site is included below. The hazards considered include: surface fault rupture; seismically induced ground failures (liquefaction, lateral spreading, dynamic compaction, and landslides), general flooding and seismically induced flooding (tsunami, seiche, and dam failure); and hydrocompactive, expansive, and corrosive soils.

5.2 SURFACE FAULT RUPTURE

The site is not in an Alquist-Priolo Earthquake Fault Zone. Based upon the reviewed geologic and seismologic reports, maps, and aerial photographs, no mapped active faults cross or project toward the site. Additionally, no evidence of active faulting was visible on the site during our site reconnaissance. Therefore, it is our opinion that the potential for fault-related surface rupture at the project site is low.

5.3 SEISMICALLY INDUCED GROUND FAILURE

5.3.1 Liquefaction

In order for soil liquefaction due to ground shaking, and possible associated effects to occur, it is generally accepted that four conditions are required:

- ☐ The subsurface soils are in a relatively loose state,
- ☐ The soils are saturated,
- ☐ The soils are fine, granular, and uniform, and
- ☐ Ground shaking of sufficient intensity to act as a triggering mechanism.

Geologic age also influences the potential for liquefaction. Sediments deposited within the past few thousand years are generally much more susceptible to liquefaction than older Holocene sediments; Pleistocene sediments are often more resistant; and pre-Pleistocene sediments are generally immune to liquefaction (Youd, et al., 2001).

Saturated granular sediments can experience liquefaction if subject to seismically induced ground motion of sufficient intensity and duration. Liquefaction analysis used procedures by

Youd et. al. (2001) and considered the relative density and fines content of the granular sediments. The analysis considered a historical high design groundwater depth of 6.7 feet bgs and measured groundwater depth of 45 feet bgs, ground acceleration (PGA_M) of 0.528g, and earthquake moment magnitude, $M_w = 6.6$.

The coarse-grained layers of sand were evaluated for potential liquefaction using the cyclic liquefaction analysis model by Youd et. al. (2001). Liquefaction analysis performed on the granular sediments indicates that liquefaction and seismically induced settlement may occur in the sandy clay and granular poorly graded sand with silt sediments at depths between 8 and 23 feet, and between 43 and 48 feet bgs. The liquefaction and settlement calculations are included in Appendix E.

Seismically induced settlement due to liquefaction was evaluated to be 0.8 inches. The general guidelines of the CGS indicate the differential seismically induced settlement across a building would be about one-half the total settlement. This would result in differential settlement across buildings of approximately 0.4-inch. The estimated differential settlement is anticipated to be within the tolerance of the proposed structures and will not result in significant damage or collapse.

Based on the depth to liquefiable soil, liquefiable soil thickness, and ground motion acceleration, surface manifestation and bearing loss may occur in the event of an earthquake. Therefore, it is recommended that a geogrid and gravel raft be utilized to mitigate the potential for bearing loss and surface manifestations below structures. Section 7.2 provides detailed recommendations for the design of a gravel raft system.

5.3.2 Dynamic Compaction

Another type of seismically induced ground failure, which can occur as a result of seismic shaking, is seismic settlement. Such phenomena typically occur in unsaturated, loose granular material or uncompacted fill soils. Dry sand settlement will be minimal (0.3-inch), and mitigation measures are not warranted.

5.3.3 Landslides and Ground Failure

According to the Fresno County General Plan (FCGP, 2023), habitable structures are prohibited on areas of unconsolidated landslide debris or in areas vulnerable to landslides. Since the

project site is located on relatively flat terrain, the potential for landslides or other slope failures from earthquake-induced ground shaking is unlikely. Strong shaking also has the potential for activating slope failures on creek banks (lurch cracking) and tension cracking in areas underlain by loose, low density soil such as uncompacted fill. Since the project site is not located near any creek banks, the potential for landslides or other slope failures from earthquake-induced ground shaking is considered unlikely.

5.4 FLOODING

5.4.1 Tsunamis, Seiches, Earthquake Induced Flooding

Tsunamis are sea waves of unusual size that occur from significant earthquakes either under the ocean floor or adjacent to shorelines and can travel great distances to impact low-lying communities and developments. Considering that the Coast Range protects the site from the sea, the potential for the site to be affected by a tsunami is nil.

A seiche is a free or standing wave oscillation that occurs in a confined body of water, such as a reservoir or lake. Earthquake-generated ground waves, which have a period that matches the natural period of the lake or reservoir, may cause the water to oscillate, which can cause damage to shoreline improvements. The FCGP indicates that earthquake-induced seiches are not considered a risk in Tranquility County.

5.4.2 Potential for Inundation Due to Dam Failure

According to the FCGP, the project does not lie within a dam inundation hazard zone. Therefore, mitigation measures such as preparing an emergency evacuation plan and route are not deemed necessary.

5.4.3 Flood Insurance Rate Maps

According to the Federal Emergency Management Agency (FEMA), the project site lies within a Zone X flood designation (Map Number 06019C2025H, dated February 18, 2009) indicating the area is determined to be outside the 0.2 percent annual chance floodplain. The civil engineer should plan site grades accordingly.

5.5 EXPANSIVE SOILS

Two (2) Expansion Index (EI) tests were performed on soil samples collected from the near surface soils of the site. The tests indicated the near surface soils have a moderate to high potential for expansion as indicated by an EI of 62 and 96. These expansive soils are susceptible to moderate volume changes associated with changes in soil moisture content. The potential for future differential movement of structures resulting from these soils can be reduced to normally tolerable levels by following the moisture conditioning, compaction, foundation, slab-on-grade, and site drainage recommendations presented herein.

5.6 HYDROCOMPACTION (SOIL COLLAPSE)

Our experience has found that some of the alluvial soils in the San Joaquin Valley are subject to hydrocompaction. Hydrocompactive soil has a relatively loose skeletal structure, which is weakly cemented by soluble salts or a slight clay mineral content. Moisture increase breaks down the inter-particle cementation causing a collapse of the skeletal structure. The significant loss in soil volume can result in settlement of overlying structures. The geotechnical exploration and laboratory testing identified that hydrocompactive characteristics were minimum. Based on the laboratory testing, post saturation of soil samples obtained from the site indicated negligible collapse potential upon inundation, therefore no mitigation for hydrocompaction is required.

5.7 CORROSIVE SOILS

The corrosion characteristics of the near surface foundation soils and any necessary mitigation measures are discussed in Section 7.7, "Corrosion Potential".

5.8 REGIONAL SUBSIDENCE

Land subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. The FCGP does not identify subsidence within the proposed project area; however, FCGP acknowledges subsidence within the county area. Due to the significant depth to groundwater withdraw in the San Joaquin Valley, the occurrence of subsidence is typically regional and unlikely to affect isolated locations, as such, the potential for damaging differential settlement of the proposed building due to subsidence is low.

6 EARTHWORK

6.1 GENERAL

Based on the laboratory data, field exploration, and geotechnical analyses, it is feasible to construct the proposed aquatic complex modernization as currently envisioned. The use of spread and continuous reinforced concrete footings bearing on engineered fill are considered appropriate for structure support provided that the recommendations presented in this report are incorporated into the project design and construction.

Site grading recommendations are presented in subsequent sections of this report. All references to relative compaction, maximum density, and optimum moisture are based on ASTM Test Method D1557. All earthwork should extend a minimum of 5 feet beyond the perimeter of proposed improvements.

6.2 SITE PREPARATION

6.2.1 Demolition of Existing Structures

Where not to remain, the existing structures (shade structures, buildings, storage buildings, etc.), pavements, and associated foundations should be removed entirely from the project site. Following the removal of these items, disturbed soils should be mitigated as described in Section 6.2.3 through 6.2.5.

6.2.2 Stripping

All surface vegetation and any miscellaneous surface obstructions should be removed from the project area, prior to any site grading. It is anticipated that stripping of vegetation and grass landscape will involve the upper 1 to 3 inches. Surface strippings should not be incorporated into fill unless they can be sufficiently blended to result in an organic content less than 3 percent by weight (ASTM D2974). Stripped topsoil, with an organic content between 3 and 12 percent by weight, may be stockpiled and used as non-structural fill (i.e. on landscape areas). If used in landscape areas, soil with an organic content between 3 and 12 percent should be placed within 2 feet of finished grade, and at least 5 feet outside of building perimeters. Soil with an organic content greater than 12 percent by weight should be excluded from fill.

6.2.3 Disturbed Soil, Undocumented Fill and Subsurface Obstructions

Initial site grading should include a reasonable search to locate disturbed soil, undocumented fill soils, debris, abandoned underground structures, and/or existing utilities that may exist within the area of construction. All underground utilities should be rerouted beyond the perimeter of the proposed improvements and all previous trench backfill and any loose soils generated by the utility removal should be removed to expose undisturbed native soil. If any areas or pockets of soft or loose soils or void spaces made by burrowing animals, undocumented fill, or other disturbed soil are encountered, they should be excavated to expose approved undisturbed native soil. Excavations for removal of the above items should be dish-shaped and backfilled with engineered fill (see Section 6.3).

6.2.4 Over-Excavation

After performing the removals described in Sections 6.2.1 through 6.2.3, the proposed project site should be over-excavated a minimum depth of 2 feet below existing ground surface or 12 inches below footings, whichever is deeper, to mitigate disturbed soils from the removal of structures and foundations. The bottom of the excavation should be processed in accordance with Section 6.2.5 and the scarified soil should be recompacted according to Table 6.3-2. The lateral limits of the over-excavation should extend at least 5 feet beyond the perimeter of the proposed improvements.

6.2.5 Scarification and Compaction

After stripping the site and performing the over-excavation and any required removals, all areas to receive fill or to support structures, or concrete flatwork should be scarified at least 12 inches below exposed subgrade elevation. The subgrade soil should be uniformly moisture conditioned according to Table 6.3-2, proof rolled to detect soft or pliant areas, and compacted to the requirements for engineered fill. Soft or pliant areas should be mitigated in accordance with Sections 6.2.3.

6.2.6 Construction Considerations

Should site grading be performed during or subsequent to wet weather, near-surface site soils may be significantly above optimum moisture content. These conditions could hamper equipment maneuverability and efforts to compact site soils to the recommended compaction

criteria. Disking to aerate, chemical treatment, replacement with drier material, stabilization with a geotextile fabric or grid, or other methods may be required to mitigate the effects of excessive soil moisture and facilitate earthwork operations. Any consideration of chemical treatment (e.g. lime) to facilitate construction would require additional soil chemistry evaluation and could affect landscape areas and some construction materials.

6.3 ENGINEERED FILL

6.3.1 Materials

All engineered fill soils should be nearly free of organic or other deleterious debris and less than 3 inches in maximum dimension. The on-site soil exclusive of debris may be used as engineered fill, provided it contains less than 3 percent organics by weight (ASTM D2874).

Recommended requirements for any imported soil to be used as engineered fill, as well as applicable test procedures to verify material suitability, are provided on Table 6.3-1.

**TABLE 6.3-1
IMPORT FILL CRITERIA**

<u>Gradation</u> <u>(ASTM C136)</u>			
<u>Sieve Size</u>		<u>Percent Passing</u>	
76 mm (3-inch)		100	
19 mm (¾-inch)		80 – 100	
No. 4		60 – 100	
No. 200		20 – 50	
<u>Expansion Index</u> <u>(ASTM D4829)</u>		<u>Plasticity</u> <u>(ASTM D4318)</u>	
		<u>Liquid Limit</u>	<u>Plasticity Index</u>
< 20		< 25	< 9
<u>Organic Content</u> <u>(ASTM D 2974)</u>			
< 3% by dry weight			
<u>Corrosivity</u>			
<u>pH</u>	<u>Minimum Resistivity</u> <u>(ohm-cm)</u>	<u>Soluble Sulfate</u> <u>(ppm)</u>	<u>Soluble Chloride</u> <u>(ppm)</u>
6 to 8	> 2,000	< 2,000	< 500
<u>Resistance Value</u> <u>(California Test Method No. 301)</u>			
R-value = 6			

The import criteria for corrosion are typical threshold limits for non-corrosive soil. All imported fill materials to be used for engineered fill should be sampled and tested by a representative of the project Geotechnical Engineer prior to being transported to the site. In addition, import fill should meet the requirements of the Department of Toxic Substances Control (DTSC), Information Advisory for Clean Imported Fill Material. The purpose of testing import soils is to ensure that “clean” fill soils are imported to otherwise “clean” sites. The testing does not require notification of the DTSC, rather the testing should be performed as part of the routine due diligence of constructing on state property and the results filed with the school district.

6.3.2 Compaction Criteria

Soils used as engineered fill should be uniformly moisture conditioned at to at least the percentages above optimum moisture indicated in Table 6.3-2, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to within the required range of relative compaction indicated on Table 6.3-2. Discing and/or blending may be required to uniformly moisture-condition soils used for engineered fill. The actual level of moisture conditioning and compaction will be based on the expansion potential and moisture tensiety relationships determined during grading. The general intent is to bring the expansive material to about 80 to 85 percent saturation at the time of construction. Preliminary design with use of on-site soil should consider criteria (bold values) for the $EI > 80$ ($PI > 25$).

**TABLE 6.3-2
MOISTURE CONDITIONING AND COMPACTION**

Soils		Relative Comaction (min – max)	Minimum Moisture Conditioning (% Over Optimum)
PI	EI		
< 9	< 20	90%	+ 0%
9 – 15	21 – 40	90-95%	+ 3%
16 – 25	41 – 80	88-92%	+ 4%
> 25	> 80	88-92%	+ 5%

6.4 TEMPORARY EXCAVATIONS

6.4.1 General

All excavations must comply with applicable local, State, and Federal safety regulations including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety is generally the responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. The information provided is a service to the client. Under no circumstances should the information provided be interpreted to mean that **TECHNICON** is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

6.4.2 Excavations and Slopes

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, State, and/or Federal Safety regulations (e.g., OSHA health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). All excavations should be constructed and maintained in conformance with current OSHA requirements (29 CFR Part 1926) for a Type B (Sandy Clay) soil.

6.4.3 Construction Considerations

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should be kept sufficiently away from the top of any excavation to prevent any unanticipated surcharging. If it is necessary to encroach upon the top of an excavation, **TECHNICON** can provide comments on slope gradients or loads on shoring to address surcharging, if provided with the geometry. Shoring, bracing, or underpinning required for the project (if any), should be designed by a professional engineer registered in the State of California.

During wet weather, earthen berms or other methods should be used to prevent run-off water from entering all excavations. All run-off should be collected and disposed of outside construction limits.

TRENCH BACKFILL

6.4.4 Materials

Pipe zone backfill (i.e., material beneath and in the immediate vicinity of the pipe), should consist of soil compatible with design requirements for the specific types of pipes. It is recommended the project designer or pipe supplier develop the material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this investigation. Randomly excavated on-site soil will likely be Class IVA material per ASTM D2321.

Trench zone backfill (i.e., material placed between the pipe zone backfill and finished subgrade) may consist of native soil which meets the requirements for engineered fill. It should be noted that the native clayey material may require significant effort to achieve compaction within narrow trenches. If granular import is used for backfill, a native clay soil or lean concrete slurry dike should be provided in the upper 4 feet where trenches cross beneath the perimeter of the

structures. This dike is intended to minimize the lateral migration of subsurface water into clay soil under the buildings. If granular import material is used for pipe or trench zone backfill, it should have a piping ratio compatible with the adjacent soil, or a geofabric separator should be utilized.

6.4.5 Compaction Criteria

All trench backfill should be placed and compacted in accordance with recommendations provided for engineered fill. Mechanical compaction is recommended; ponding or jetting should not be used.

7 DESIGN RECOMMENDATION

7.1 GENERAL

The proposed structures may be supported by conventional shallow spread footings and isolated spread footings under buildings supported on properly engineered fill. The investigation has revealed the presence of expansive soils, which will dictate the implementation of specific design measures to minimize the amount of future movement due to the expansive soils. The following recommendations are based on the assumption that the recommendations in Section 6, "Earthwork", have been implemented. Recommendations regarding the geotechnical aspects of building design are presented in subsequent sections.

7.2 SPREAD FOOTINGS

Considering the presence of moderately expansive clay soils, it is recommended that all exterior footings be continuous and embedded at least 24 inches below the lowest adjacent grade and all interior footings be embedded at least 18 inches below the lowest adjacent grade. The use of isolated footings outside of the slab-on-grade is discouraged unless abutted entirely by hardscape. As a minimum, continuous footings should be reinforced with two #4 bars near the top and two #4 bars near the bottom (4 bars total). Clay subgrade within 12 inches of the footing subgrade should have a moisture content of at least 5 percent above optimum, immediately prior to placing the footing concrete.

Foundation depths and reinforcement should also satisfy structural and constructability considerations. These recommendations are based on engineering judgement and experience associated with expansive soil and is not based on any structural analysis. Any additional reinforcement for structural considerations should be provided by the structural engineer. These recommendations should be reviewed by the project engineer or building designer and they should concur with the recommendations provided.

A geogrid and gravel raft system is recommended to be installed below foundations for structures at the project site to mitigate the effects of surface manifestation and potential bearing loss. The system should consist of the proposed structures supported on a minimum of 12 inches of Class II aggregate base over Tensar InterAx NXST geogrid. The gravel raft should be placed at a uniform depth for each structure, and such that the top of the aggregate base layer coincides with the bottom depth of the deepest foundation for each structure. The geogrid

should be placed on native soil or engineered fill in accordance with the referenced report and covered with Class II aggregate base compacted to at least 90 percent relative compaction and moisture conditioned at optimum moisture. The geogrid and gravel raft system should extend laterally a minimum of 10 feet beyond the perimeter of foundations.

7.2.1 Vertical Bearing Pressures and Settlements – Strip and Spread Foundations

Generally, two geotechnical issues determine the design bearing pressure for conventional spread footing foundations: strength of the foundation soil, and tolerable settlement. For lightly loaded structures, design bearing may be determined by constructability considerations or code-required minimum dimensions.

Table 7.2-1 presents the allowable available bearing capacity for static loading which includes dead load plus live load (D.L. + L.L.) and total combined loading (D.L. + L.L. + transient loading, such as wind or seismic), and unfactored nominal bearing.

**TABLE 7.2-1
BEARING CAPACITY**

	Bearing Capacity (psf)
Static Loading	2,000
Total Combined Loading	3,000
Unfactored Ultimate Bearing	6,000

The above bearing capacities are appropriate for design using the Basic and Alternative Load Combinations in Section 1605.3 of the 2022 CBC.

Analysis, based on methods by Hough and consolidation theory, determined the following estimated static and maximum settlement based on a range of assumed design bearing and estimated structural loads. The maximum settlement is anticipated to occur overtime due to compressible soils encountered on-site. The estimated settlements presented in Table 7.2-2 are based on the assumption that the sustained load of footings is equal to 80 percent of the total load.

**TABLE 7.2-2
 ESTIMATED SETTLEMENT**

Footings Type	Loading (DL + LL)	Design Bearing (psf)	Estimated Initial Settlement (inch)	Estimated Total Settlement (inch)
Strip	3 kips/ft	2,000	0.55	1.10
Square	30 kips	2,000	0.65	1.30

If deemed necessary by the design engineer, **TECHNICON** can provide the estimated settlement for other loading conditions.

7.2.2 Lateral Resistance

Lateral loads applied to foundations can be resisted by a combination of passive lateral bearing and base friction. Table 7.2-3 presents the allowable and ultimate passive pressures and frictional coefficients.

**TABLE 7.2-3
 PASSIVE PRESSURES AND FRICTIONAL RESISTANCE**

	Allowable		Ultimate
	Static	Total Combined	
Sliding Resistance	0.13N + 400 psf	0.17N + 530 psf	0.26N + 800 psf
Passive Pressure	120 psf/ft + 1145 psf	165 psf/ft + 1525 psf	245 psf/ft + 2285 psf
Lateral Translation Needed to Develop Passive Pressure	0.02 D	0.03 D	0.04 D

Note: 1) D is the footing depth (ft)

Due to the expansive soils at the site, passive resistance should not be used within the top 12 inches of footings unless abutted by hardscape. If the deflection resulting from the strain necessary to develop the passive pressure is beyond structural tolerance, additional passive pressure values could be provided based on tolerable deflection. The passive pressure and frictional resistance can be used in combination. The allowable values already incorporate a factor of safety and, as such, would be compared directly to the driving loads. If analytical approaches require the input of a safety factor, the ultimate values would be used.

7.2.3 Design and Construction Considerations

Prior to placing steel or concrete, footing excavations should be cleaned of all debris, loose soft soil, and water. All footing excavations should be observed by a representative of the project Geotechnical Engineer immediately prior to placing steel or concrete. The purpose of these observations is to verify that the bearing soils encountered in the foundation excavations are similar to those assumed in the analysis and to verify these recommendations are implemented.

7.3 EARTH RETAINING STRUCTURES

If project improvements will include retained earth systems, the lateral earth pressure against retaining structures will be dependent upon the ability of the wall to deflect. Presented in Table 7.3-1 are the active, at-rest, and braced lateral earth pressures for on-site soil. The active pressure is applicable to walls able to rotate 0.0005 radians at the top or bottom. The at-rest soil pressure is applicable to retaining structures that are fully fixed against both rotation and translation. Walls restrained from translation at the top and bottom, but able to deflect 0.0005 radian between restrained points should be designed for the braced lateral pressure.

**TABLE 7.3-1
LATERAL EARTH PRESSURES**

	Lateral Earth Pressures	
	Drained	Undrained
Active Pressure (psf/ft of depth)	65	45 psf + Hydrostatic
At-Rest Pressure (psf/ft of depth)	115	54 psf + Hydrostatic
Braced Pressure (psf)	42 H	29 psf + Hydrostatic

Note: H in the expression represents the retained height in feet (measured from finished grade to bottom of footing).

Retaining wall foundation design can utilize the passive pressures and frictional resistance given in Table 7.2-3 and the bearing capacities given in Table 7.2-1. When utilizing the bearing capacities of Table 7.2-1, the static loading value represents the average bearing for the footing and the total combined loading value presents the allowable maximum toe pressure.

7.4 SLABS-ON-GRADE

7.4.1 Subgrade Preparation

Slabs-on-grade should be supported on recompacted soils or engineered fill placed as described in Section 6.3 of this report. Subgrade soils within 24 inches of pad grade should have a moisture content of at least 5 percent above optimum immediately prior to placing the slab concrete, or placing the vapor retarding membrane.

7.4.2 Capillary and Moisture/Vapor Break

Considering the soil type and regional groundwater depth, a capillary break (i.e. clean sand or gravel layer) is not considered necessary.

In areas to receive moisture-sensitive floor coverings, it is recommended that the subgrade be covered by a 10 mil vapor retarding membrane meeting the specifications of ASTM E1745, (Class C with minimum puncture resistance of 475 grams). The subgrade surface should be smooth and care should be exercised to avoid tearing, ripping, or otherwise puncturing the vapor retarding membrane. If the vapor retarding membrane becomes torn or disturbed, it should be removed and replaced or properly patched. Considering the soil type and regional groundwater depth, a capillary break (i.e., clean sand or gravel layer) is considered unnecessary.

The vapor retarding membrane could be covered with approximately 1 to 2 inches of saturated surface dry (SSD) sand to protect it during construction. Concrete should not be placed if sand overlying the vapor barrier has been allowed to attain a moisture content greater than about 5 percent (due to precipitation or excessive moistening). In addition, penetrations through the concrete slab shall be sealed or protected to prevent inadvertently introducing excess water into the sand cushion layer due to curing water, wash-off water, rainfall, etc. Excessive water beneath interior floor slabs could result in future significant vapor transmission through the slab, adversely affecting moisture-sensitive floor coverings and could inhibit proper concrete curing.

According to American Concrete Institute (ACI) 302.2R-06, concrete could be placed directly on the vapor retarding membrane to minimize the potential for developing a reservoir of moisture in the sand layer, which could lead to future moisture entrapment and potential moisture and flooring problems. If concrete is placed directly on the membrane, care should be taken to not damage the membrane and special concrete curing methods implemented to minimize potential

slab curing problems. If the protective sand layer is not used, the building designer should be in agreement. Many slab designers feel the sand cushion is important to proper concrete curing as well as minimizing slab curling issues.

Although slab support currently the industry standard, this system might not be completely effective in preventing floor slab moisture vapor transmission problems. This system will not necessarily assure that floor slab moisture transmission rates will meet floor-covering manufacturer standards and that indoor humidity levels will not inhibit mold growth. A qualified specialist(s) with knowledge of slab moisture protection systems, flooring design and other potential components that may be influenced by moisture, should address these post-construction conditions separately. The purpose of a geotechnical investigation is to address subgrade conditions only, and consequently, it does not evaluate future potential conditions.

7.4.3 Conventional Slab Design

To accommodate the potential for expansive soils, the minimum reinforcement of concrete floor slabs should consist of #3 bars spaced at 18 inches on center in both principle directions or equivalent. The reinforcement is based on engineering judgement and experience with expansive soils, not on any structural analysis. The reinforcement assumes a nominal slab thickness of 5 inches. Slab thicknesses and reinforcement must also satisfy structural considerations. A modulus of subgrade reaction, K_p ($B_p = 1$ foot), of 200 pci may be used for elastic analysis of slabs on properly compacted subgrade. Slab concrete should have good density, a low water/cement ratio, and proper curing to promote a low porosity and reduce moisture vapor transmission.

7.5 PIER FOUNDATIONS

Pier foundations may be desirable for support of shade structures, lighting, etc. Presented in Table 7.5-1 are expressions for the allowable and ultimate friction resistance vales for vertical compression loads on pier foundations.

**TABLE 7.5-1
ALLOWABLE AXIAL CAPACITY**

	Frictional Resistance for Vertical Loads in Compression (lbs)
Static Loading	$25 DL^2 + 1,255 DL$
Total Combined Loading	$30 DL^2 + 1,675 DL$
Unfactored Ultimate Capacity	$45 DL^2 + 2,510 DL$

Note: 1) D is pier diameter in feet and L is embedment length in feet.
2) The allowable uplift resistance would be 70 percent of the compressional resistance.

The allowable passive pressure to resist lateral loads on isolated piers may be taken as 90 psf per foot of depth of embedment. The value may be increased by one-third for the total combined loads, including wind and seismic. The passive pressure values already consider arching and, as such, should not be increased further. The passive pressure only considers soil strength. Tolerable pier deflection may govern the design lateral resistance. If provided with pier geometry, lateral load, and loading eccentricity, **TECHNICON** can provide the estimated pier head deflection.

7.6 PAVEMENT DESIGN

7.6.1 Design R-value and Traffic Assumptions

The R-value for the on-site soil was evaluated in the laboratory on bulk samples of subgrade soil taken at two (2) locations from the upper 3 feet within proposed pavement areas. The tested soils had measured R-values of 6. The laboratory testing conformed to Caltrans Test Method 301. Based on the tested values, an R-value of 6 is recommended for pavement design. If requested, additional samples could be collected after grading has been performed in order to reevaluate the design R-value.

Detailed vehicular load and frequency information was not provided for this project at the time this report was prepared. Traffic on the site is anticipated to consist of parking and drives for automobiles and regular school bus traffic. Consequently, a range of pavement sections have been provided based on Traffic Indexes (T.I.'s) of 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5 and 8.0. These traffic design assumptions should be reviewed for compatibility with the actual development, and revised pavement sections developed, as necessary.

7.6.2 Asphalt Concrete Pavement Design

Flexible pavement design recommendations have been developed for the given T.I.'s based upon the California Department of Transportation (Caltrans) design procedures and a design R-value of 6. The flexible asphalt concrete pavement sections associated with the assumed T.I.'s for on-site asphalt pavements are summarized in Table 7.6-1.

**TABLE 7.6-1
RECOMMENDED MINIMUM PAVEMENT SECTIONS**

Traffic Index	Asphalt Concrete (inches)	Aggregate Base – Class 2 (inches)
4.5	2.5	9.0
5.0	2.5	11.0
5.5	3.0	11.5
6.0	3.0	13.5
6.5	3.5	14.5
7.0	4.0	15.5
7.5	4.5	16.5
8.0	4.5	18.5

The design criteria assumes a 20-year design period and that normal maintenance (crack sealing, etc.) is performed. The traffic index is a measure of the volume of truck traffic that will be applied to a pavement section in the design life. The allowable average daily truck traffic (ADTT) for the assumed traffic indexes is presented in Table 7.6-2.

**TABLE 7.6-2
AVERAGE DAILY TRUCK TRAFFIC**

Traffic Index	2-Axle Vehicle	or	3-Axle Vehicle	or	5-Axle Vehicle
4.5	2.2		0.8		0.2
5.0	5.2		2.0		0.5
5.5	11.6		4.3		1.1
6.0	24.1		9.0		2.4
6.5	47.3		17.7		4.7
7.0	88.1		33.0		8.8
7.5	157.3		59.0		15.8
8.0	270.6		101.5		27.1

The flexible pavement should conform to and be placed in accordance with the Caltrans Standard Specifications, 2015. The aggregate base (Class 2) should comply with the specifications in Sections 26. The aggregate base and upper 12 inches of subgrade should be compacted to a minimum of 95 percent relative compaction as determined by Caltrans Test Method 216 (Dry determination) or ASTM D1557 test procedures.

7.6.3 Moisture Considerations

The pavement design should consider both the vehicular loading, as well as the environmental factors. The vehicular loading will depend on the amount and type of traffic anticipated for the pavement design life. Environmental factors include the potential for moisture variations beneath the pavement structural section. It is recommended that all pavement areas conform to the following criteria:

- ☐ All trench backfill, including utility and sprinkler lines, should be properly placed and adequately compacted to provide a stable subgrade.
- ☐ Adequate drainage should be provided to prevent surface water from ponding and saturating the subgrade soil.
- ☐ A periodic maintenance program should be incorporated.
- ☐ All concrete curbs separating pavement and landscaped areas should extend to the subgrade.

7.6.4 Construction Considerations

In the event unstable (pumping) subgrades are encountered within planned pavement areas, we recommend a heavy, rubber-tired vehicle (typically a loaded water truck) be used to test the load/deflection characteristics of the finished subgrade materials. It is recommended this vehicle have a minimum rear axle load (at the time of testing) of 16,000 pounds with tires inflated to at least 65 psi pressure. If the tested surface shows a visible deflection extending more than 6 inches from the wheel track at the time of loading, or a visible crack remains after loading, corrective measures should be implemented. Such measures could include diskings to aerate, chemical treatment, replacement with drier material, or other methods. It is recommended **TECHNICON** be retained to assist in developing which method (or methods) would be applicable for this project.

7.7 CORROSION POTENTIAL

Two (2) soil samples from the near surface of the site were tested for pH, minimum electrical resistivity, and soluble sulfate and chloride.

The pH of the soil tested was 7.83 and 7.66 and the minimum electrical resistivity was 1,012 and 261 ohm-cm. These values are generally representative of an environment that could be moderately corrosive to buried unprotected metals. Utilizing methods provided in Caltrans California Test 643, "Method for Estimating the Service Life of Steel Culverts", an 18-gauge steel zinc-coated culvert is estimated to have an average maintenance-free service life (years to perforation) exceeding 19 years. Therefore, if project improvements will involve metal that comes into contact with the on-site soil, the design should consider this potential soil corrosiveness described.

Test results suggest that low to moderate levels of soluble sulfates (133 and 432 ppm) and low levels of soluble chlorides (65 and 78 ppm) are present in on-site soils. Normal cement (Type II) and normal reinforcement cover should be adequate for foundation concrete that comes in contact with the foundation soils.

Corrosion is dependent upon a complex variety of conditions, which are beyond the geotechnical practice. Consequently, a qualified corrosion engineer should be consulted if the owner desires more specific recommendations.

7.8 SITE DRAINAGE

Providing and maintaining adequate site drainage to prevent entrapment and ponding of surface water and excessive moisture migration into the subgrade soil is very important. Poor perimeter or surface drainage could cause reduced subgrade support. The site should incorporate the basis for good drainage. This includes:

- ❑ Sufficient pad height to allow for proper drainage; and
- ❑ Defined drainage gradients away from the structure to points of conveyance, such as drainage swales and/or area drains and discharge pipe.

The maintenance personnel must maintain the established drainage by not blocking or obstructing gradients away from structures without providing some alternative drainage means (e.g., area drains and subsurface pipes). If planter or landscape areas are established near the structures, it is important to prevent surface run-off from entering the planter and care must be taken not to over irrigate and to maintain a leak-free sprinkler piping system. Consideration should be given to use of low volume emitter irrigation systems for planters. Well-maintained low-volume emitter irrigation (drip system) is best suited for planters adjacent to structures. Watering practices must strive to use only sufficient water to sustain and promote plant growth.

8 ADDITIONAL SERVICES

8.1 DESIGN REVIEW AND CONSULTATION

It is recommended that **TECHNICON** be retained to review those portions of the contract drawings and specifications that pertain to earthwork, foundations, and pavements prior to finalization to determine whether they are consistent with our recommendations.

8.2 CONSTRUCTION OBSERVATION AND TESTING

It is recommended that a representative of **TECHNICON** observe the excavation, earthwork, pavements, and foundation, phases of work to determine that the subsurface conditions are compatible with those used in the analysis and design. **TECHNICON** can conduct the necessary field testing and provide results on a timely basis so that action necessary to remedy indicated deficiencies can be taken in accordance with the plans and specifications. Upon completion of the work, a written summary of our observations, field testing, and conclusions regarding the conformance of the completed work to the intent of the plans and specifications will be provided. This additional service is not part of this current contractual agreement. **TECHNICON** firm will not be responsible for establishing or confirming building or foundations depths or locations unless retained to do so.

9 LIMITATIONS

The conclusions and recommendations presented in this report are based on the information provided regarding the proposed construction, and the results of our field and laboratory investigation, combined with interpolation of the subsurface conditions between boring locations. The nature and extent of the variations between borings may not become evident until construction. If variations or undesirable conditions are encountered during construction, our firm should be notified promptly so that these conditions can be reviewed and our recommendations reconsidered where necessary. The unexpected conditions frequently require additional expenditures for proper construction of the project. **TECHNICON Engineering Services, Inc.** will not assume any responsibility for errors or omissions if the final extent and depth of earthwork is not determined by our firm at the time of construction due to said variations or undesirable conditions encountered.

If the proposed construction is relocated or redesigned, or if there is a substantial lapse of time between the submission of our report and the start of work at the site, or if conditions have changed due to natural causes, or construction operations at or adjacent to the site, the conclusions and recommendations contained in this report should be considered invalid unless the changes are reviewed and our conclusions and recommendations modified or approved in writing. Such conditions may require additional field and laboratory investigations to determine if our conclusions and recommendations are applicable considering the changed conditions or time lapse.

It is the responsibility of the contractor to provide safe working conditions with respect to excavation slope stability. This report does not relieve the contractors of responsibility for temporary excavation construction, bracing and shoring in accordance with CAL OSHA requirements.

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. This report should not be construed as an environmental audit or study.

This report has been prepared for the sole use by Golden Plain Unified School District and their designated consultants for the proposed aquatic complex modernization to be constructed at Tranquility High School in Tranquility, California. Recommendations presented in this report should not be extrapolated to other areas or used for other projects without prior review. This report has been prepared with the intent that the firm of **TECHNICON** will be performing the construction testing and observation for the complete project. If, however, another firm or individual(s) should be retained or employed to use this geotechnical investigation report for the purpose of construction testing and observation, notice is hereby given that **TECHNICON** will not assume any responsibility for errors or omissions, if any, which may occur and which could have been avoided, corrected, or mitigated if **TECHNICON**, had performed the work. This notice also applies to the misuse or misinterpretation of the conclusions and recommendations outlined in this report. Furthermore, the other firm or individual(s) performing construction testing and observation should accept transfer of responsibility of the work, as required by the California Building Code, in writing to the project owner and **TECHNICON**. The firm accepting transfer of responsibility should perform additional investigation(s) as may be necessary to develop their own conclusions, evaluations, and recommendations for design and construction.

10 REFERENCES

- ASCE 7 Hazard Tool, <http://asce7hazardtool.online/>
- California Building Code, (2022), Vol. 2, California Building Standards Commission.
- California Dam Breach Inundation Map Web Publisher (<http://fmds.water.ca.gov/maps/damim/>)
- California Department of Transportation, California Test Method No. 643, Method for Estimated the Service Life of Steel Culverts (1999)
- California Department of Water Resources, Sustainable Groundwater Management Agency Data Viewer (Spring 2021)
- California Department of Water Resources (<http://www.water.ca.gov/waterdatalibrary/>)
- Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J. (2003), The Revised 2002 California Probabilistic Seismic Hazards Maps, California Geological Survey, June 2003
- CGS, Alquist-Priolo Earthquake Fault Zone (2000)
- CGS, (1986), Guidelines to Geologic/Seismic Reports: Note 42
- CGS, (1986), Guidelines for Preparing Engineering Geologic Reports: Note 44
- CGS (2002), California Geomorphic Provinces: Note 36
- CGS, (2022), Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings: CGS Note 48
- CGS, Fault Activity Map of California (2010), Compiled by Charles W. Jennings, William A. Bryant, George Saucedo
- CGS, Fault-Rupture Hazard Zones in California, Special Publication 42
- CGS, (2008), Guidelines for Evaluating and Mitigating Seismic Hazards, Special Publication 117A
- CGS, (2019), Significant California Earthquakes
- Croft, M.G., 1972, Subsurface Geology of the late Tertiary and Quaternary Water Bearing Deposits of the Southern part of the San Joaquin Valley, California, USGS Water – Supply Paper 1999 – H
- Federal Emergency Management Agency, Flood Insurance Rate Maps, Tranquility County, California: No. 06019C2025H (February 18, 2009)
- Field, E.H., and 2014 Working Group on California Earthquake Probabilities, 2015, UCERF3: A new earthquake forecast for California's complex fault system: U.S. Geological Survey 2015-3009, 6 p., <https://dx.doi.org/10.3133/fs20153009>
- Fresno County General Plan (2023)
- Seed, et al. 2003, Recent Advances in Soil Liquefaction Engineering, A Unified and Consistent Framework
- Seeburger and Bolt (1976)

- Structural Engineers Association of California “Seismic Design Maps”, <http://seismicmaps.org>
- Topozada et al. (1978, 1981)
- USGS, (2018), Tranquility, Quadrangle 7½-Minute Series (Topographic)
- USGS, Earthquake Hazards Program, California Earthquake History (1800 – present),
<http://earthquake.usgs.gov>
- Youd, T.L., et al. (2001) Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils: Journal of Geotechnical and Environmental Engineering , Vol. 127, No. 10, October 2000

FIGURES

1 through 7



LAT.: 36.6453°N, LONG.: 120.2529°W, 8-T15S-R16E, MDB&M



PROJECT:
240282

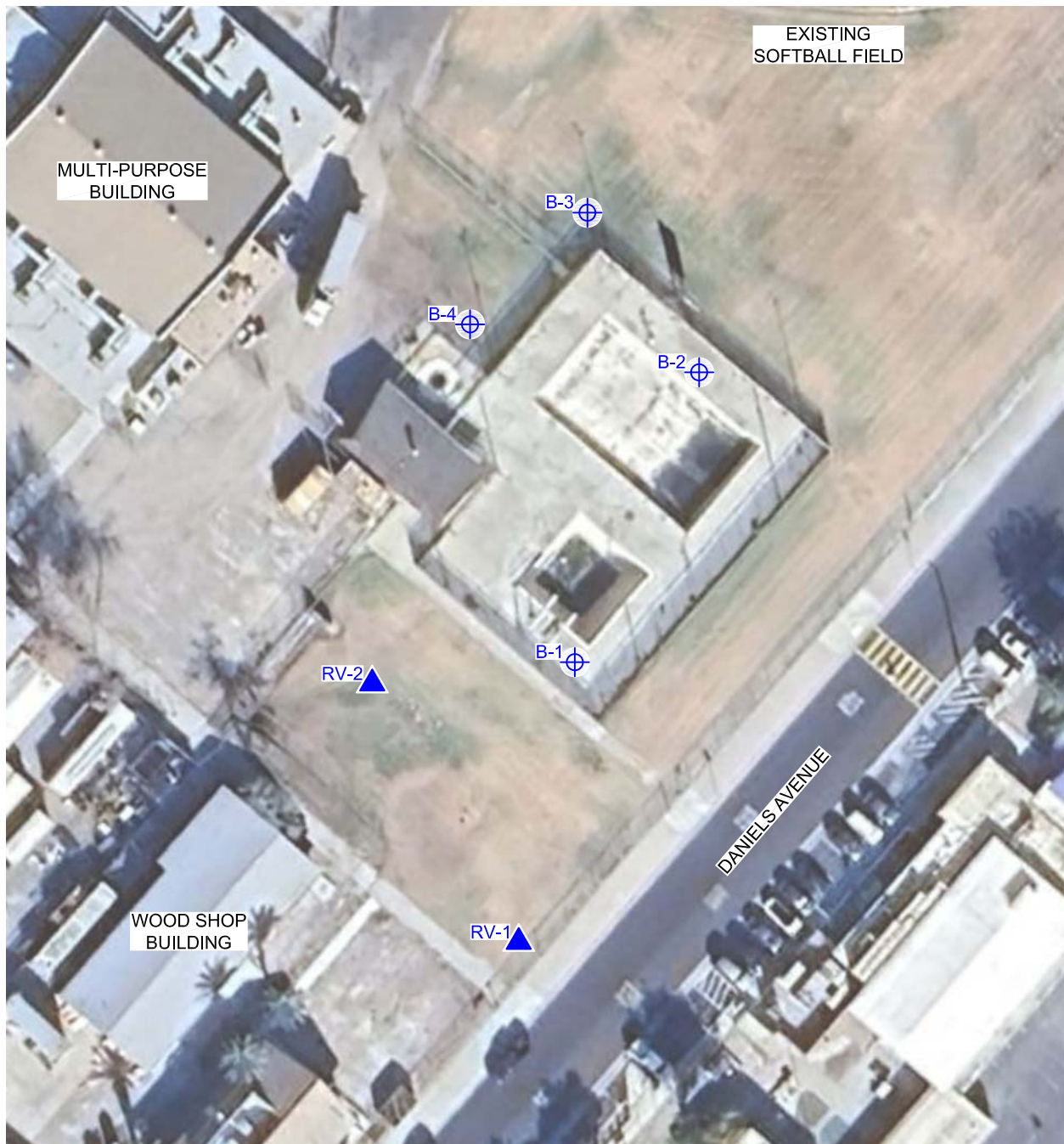
SOURCE: USGS
TOPOGRAPHIC MAPS

VICINITY MAP
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILLITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILLITY, CALIFORNIA

FIGURE

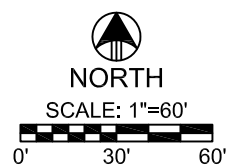
1

NTS



▲ =R-VALUE LOCATIONS

⊕ =SOIL BORING LOCATIONS



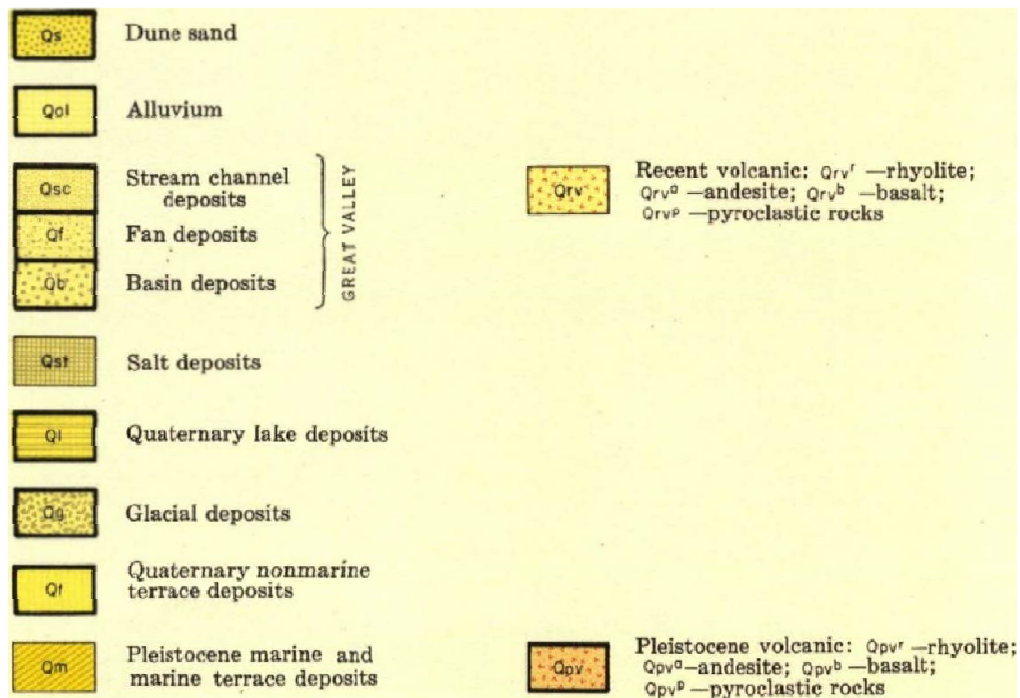
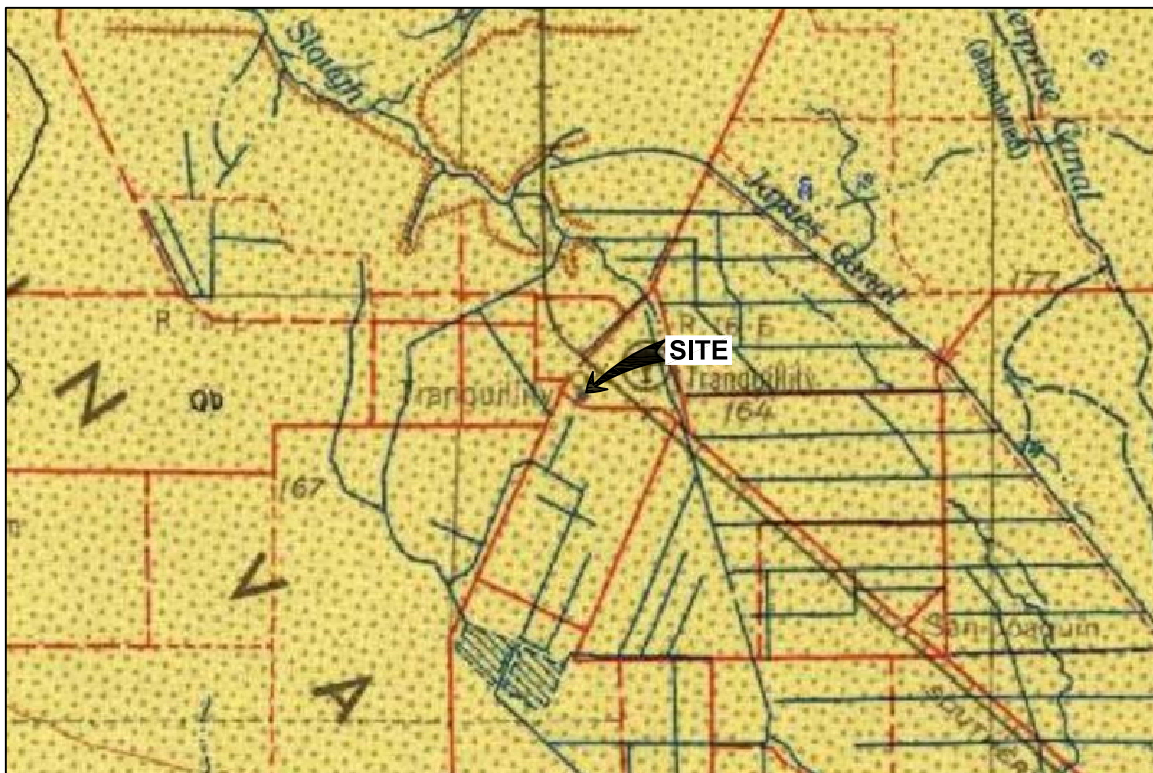
PROJECT:
240282

SOURCE:
GOOGLE EARTH

SITE MAP
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILITY, CALIFORNIA

FIGURE

2



GEOLOGIC MAP OF CALIFORNIA : SANTA CRUZ SHEET, SCALE 1:250,000 - 1958



PROJECT:
240282

SOURCE:
DIVISION OF MINES
AND GEOLOGY

REGIONAL GEOLOGIC MAP
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILITY, CALIFORNIA

FIGURE

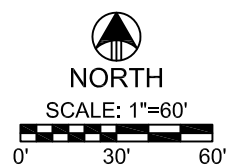
3

NTS



Qb = GREAT VALLEY BASIN DEPOSITS

⊕ = SOIL BORING LOCATIONS



PROJECT:
240282

SOURCE:
GOOGLE EARTH

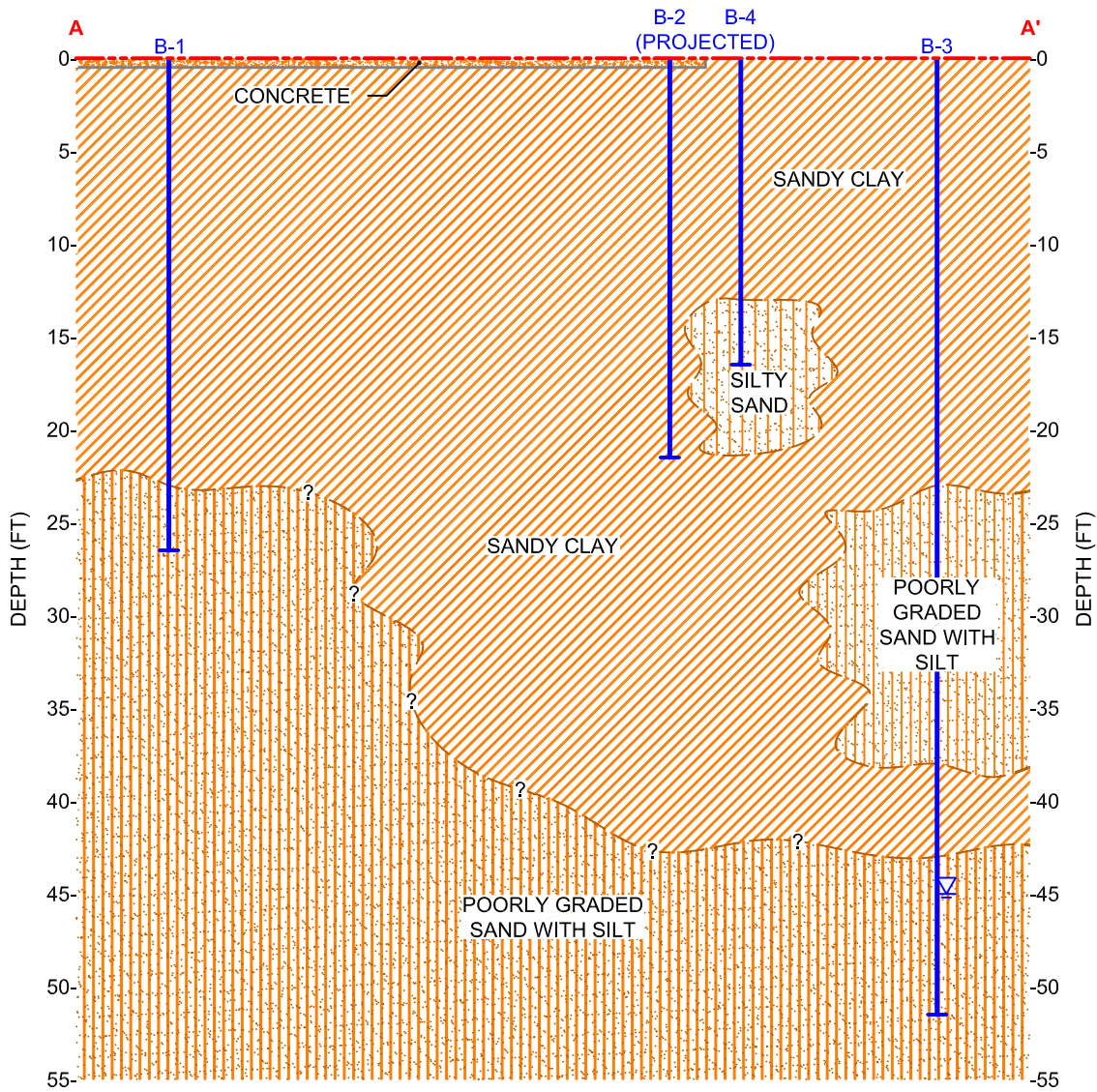
GEOLOGIC MAP OF SITE
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILITY, CALIFORNIA

FIGURE

4




 NORTH
 SCALE: 1"=40'



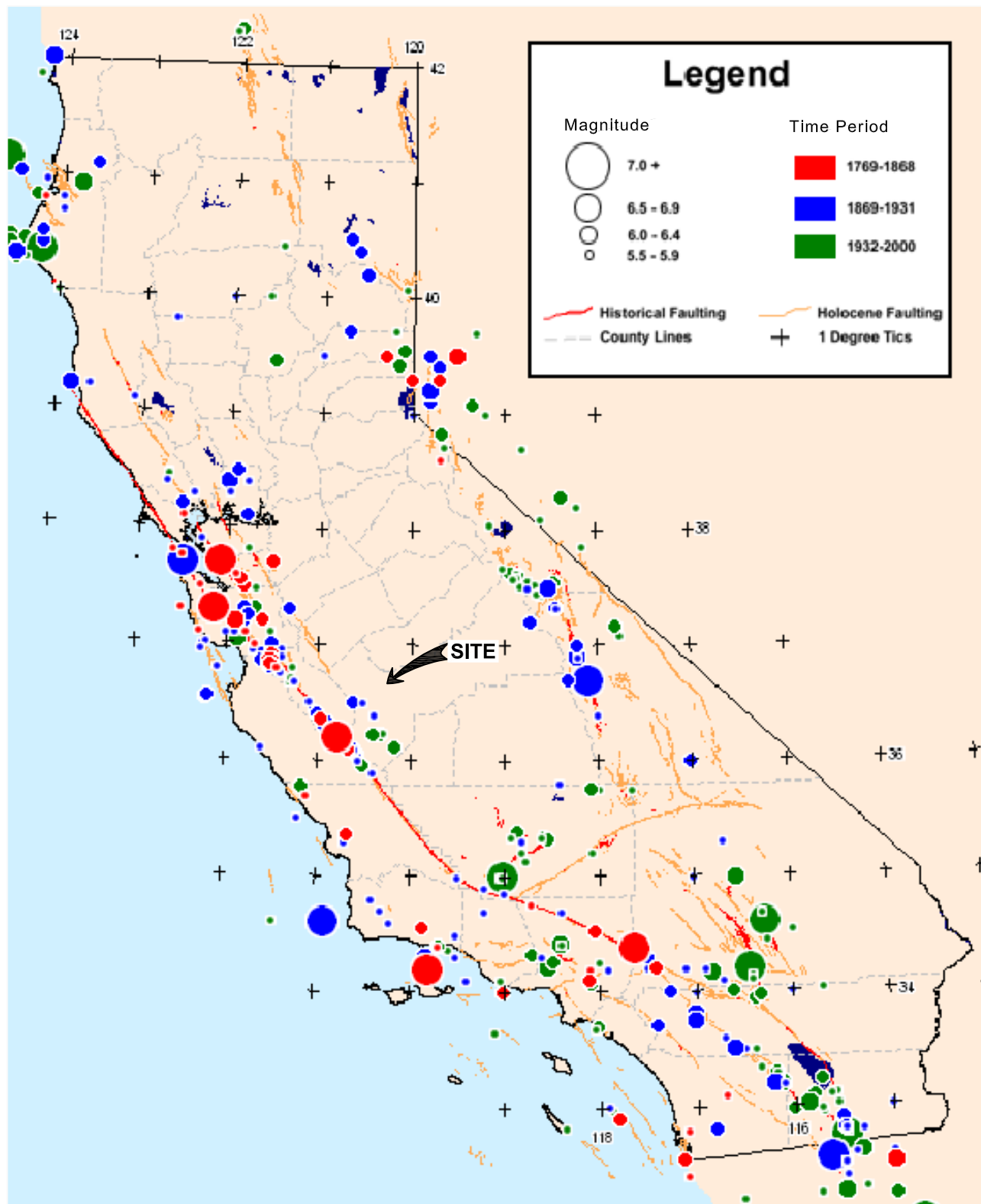
PROJECT:
240282

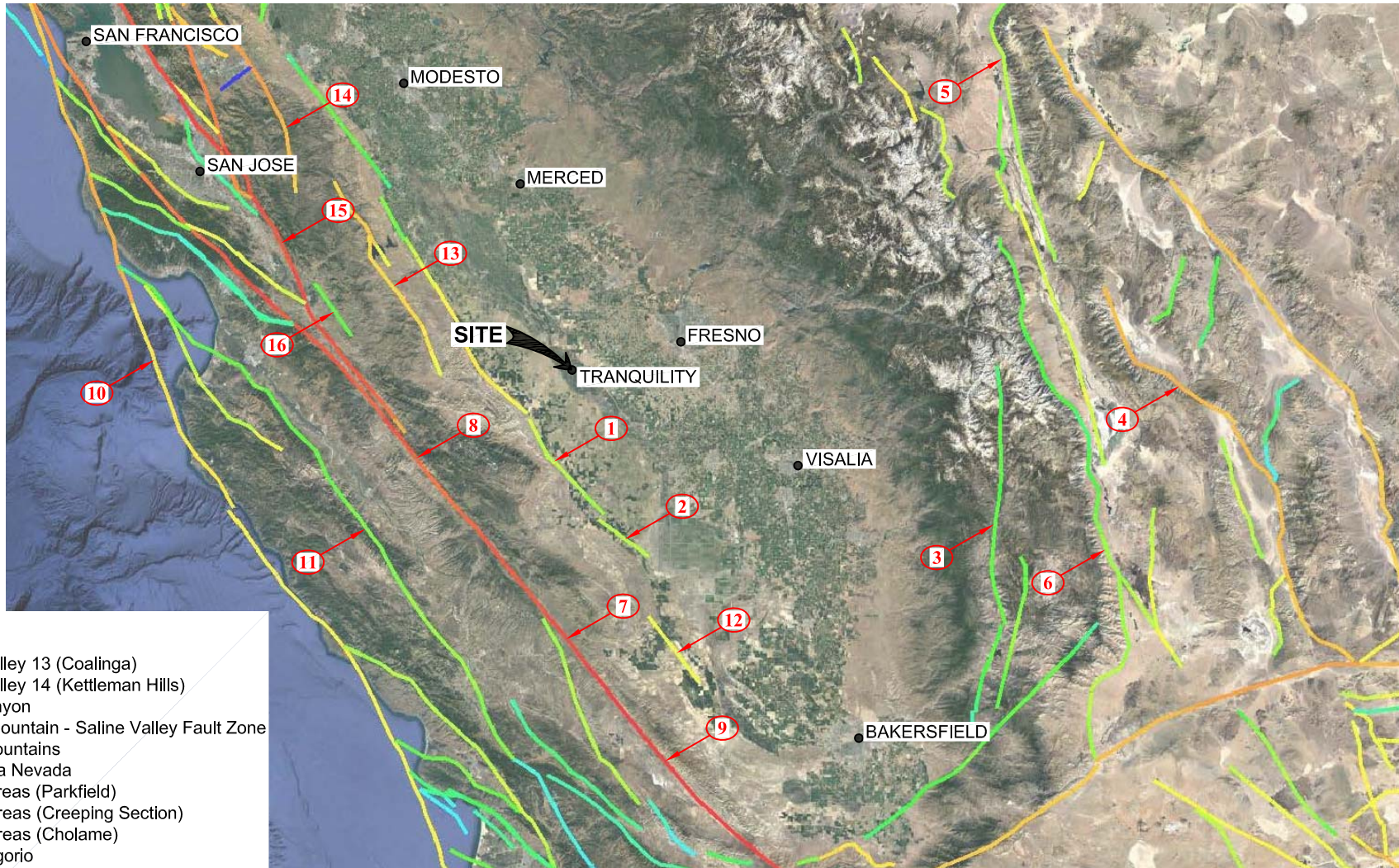
CAD BY:
MH

CROSS SECTION A-A'
 PROPOSED AQUATIC COMPLEX MODERNIZATION
 TRANQUILITY HIGH SCHOOL
 6052 JUANCHE AVENUE
 TRANQUILITY, CALIFORNIA

FIGURE

5





FAULTS

1. Great Valley 13 (Coalinga)
2. Great Valley 14 (Kettleman Hills)
3. Kern Canyon
4. Hunter Mountain - Saline Valley Fault Zone
5. White Mountains
6. SO Sierra Nevada
7. San Andreas (Parkfield)
8. San Andreas (Creeping Section)
9. San Andreas (Cholame)
10. San Gregorio
11. Reliz
12. Lost Hills
13. Ortigalita
14. Greenville
15. Calaveras
16. Quien Sabe



PROJECT:
240282

DATE:
6/14/24

SOURCE:
WGCEP

APPROVED BY:
AA

REGIONAL FAULT ACTIVITY MAP
PROPOSED AQUATIC COMPLEX MODERNIZATION
TRANQUILITY HIGH SCHOOL
6052 JUANCHE AVENUE
TRANQUILITY, CALIFORNIA

FIGURE

7

NTS

BORING LOGS AND LOG KEY

APPENDIX A



TECHNICON Engineering Services, Inc.
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Telephone: 559.276.9311

KEY TO SYMBOLS

PROJECT NAME Proposed Aquatic Complex Modernization

DATE OF EXPLORATION 5/14/2024

PROJECT LOCATION Tranquility, California

PROJECT NUMBER 240282

LITHOLOGIC SYMBOLS (Unified Soil Classification System)



FILL



SW WELL GRADED SAND



SP POORLY GRADED SAND



SM SILTY SAND



SC CLAYEY SAND



PT PEAT



OL LOW PLASTICITY ORGANIC SILT



OH HIGH PLASTICITY ORGANIC SILT



ML LOW PLASTICITY SILT



MH HIGH PLASTICITY SILT



GW WELL GRADED GRAVEL



GP POORLY GRADED GRAVEL



GM SILTY GRAVEL



GC CLAYEY GRAVEL



CL LOW PLASTICITY CLAY



CH HIGH PLASTICITY CLAY

SAMPLER SYMBOLS



STANDARD PENETRATION TEST



CALIFORNIA SAMPLER



MODIFIED CALIFORNIA SAMPLER



SHELBY TUBE SAMPLER



ROCK CORE BARREL



BULK SAMPLE



Water Level at Time of Drilling



Water Level at End of Drilling



Water Level After 24 Hours



Assumed stratum line



Observed stratum line

Note 1: The degree of saturation shown on the boring logs is based on an assumed specific gravity of 2.65. The actual degree of saturation may vary.

Note 2: The stratum lines shown on the logs represent the approximate boundary between soil types; the actual in-situ transition may be gradual.

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
S - DEGREE OF SATURATION (%)
NP - NON PLASTIC
200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
ND - NOT DETECTED

TV -TORVANE
PID -PHOTOIONIZATION DETECTOR
UC -UNCONFINED COMPRESSION
ppm -PARTS PER MILLION
TPH-d -TOTAL PETROLEUM HYDROCARBON AS DIESEL
TPH-mo -TOTAL PETROLEUM HYDROCARBON AS MOTOR OIL



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BORING B-1

PAGE 1 OF 1

PROJECT NAME Proposed Aquatic Complex Modernization **PROJECT NUMBER** 240282
PROJECT LOCATION Tranquility, California **SURFACE DESCRIPTION** concrete
DATE STARTED 5/14/24 **COMPLETED** 5/14/24 **GROUND ELEVATION** 0 ft
DRILLING CONTRACTOR TECHNICON Engineering Services, Inc. **GROUND WATER LEVEL** No groundwater encountered.
DRILL RIG TYPE SIMCO 2800 **BORING DEPTH** 26.5 ft
DRILLING METHOD Solid Flight Auger **LOGGED BY** C. Odneal **CHECKED BY** A. AhTye

BOREHOLE - TECHNICON GDT - 6/14/24 14:25 - Z:\TESDATA\PROJECTS\PROJECTS\240200-240299\240282 AQUATIC COMPLEX MODERNIZATION\REPORT\240282 - GINT.GPJ

DEPTH (ft)	SAMPLE TYPE	BLOWS/ft	GRAPHIC LOG	MATERIAL DESCRIPTION	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	REMARKS
0				CONCRETE - 6 inches				
	CAL	4-7-7 (14)		Sandy CLAY (CL) - stiff, dark brown, moist, medium plasticity	97.4	23.8	PP = 1.25 tsf S = 91 %	
5								
	CAL	4-10-12 (22)		Light brown	106.4	18.6	PP = 4 tsf S = 89 %	
	GB							
10								
	SPT	2-4-4 (8)		Increased sand				
15								
	CAL	7-12-12 (24)		Very stiff	113.5	16.6	S = 96 %	
20								
	SPT	3-5-5 (10)		Stiff, grayish brown				
25								
	CAL	12-18-20 (38)		Poorly Graded SAND WITH SILT (SP-SM) - dense, light brown, moist, fine grained	95.5	7.0	S = 25 %	

NOTES:

1. Bottom of boring at 26.5 feet.
2. No groundwater encountered.
3. Boring backfilled with auger cuttings.



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BORING B-2

PAGE 1 OF 1

PROJECT NAME Proposed Aquatic Complex Modernization **PROJECT NUMBER** 240282
PROJECT LOCATION Tranquility, California **SURFACE DESCRIPTION** concrete
DATE STARTED 5/14/24 **COMPLETED** 5/14/24 **GROUND ELEVATION** 0 ft
DRILLING CONTRACTOR TECHNICON Engineering Services, Inc. **GROUND WATER LEVEL** No groundwater encountered.
DRILL RIG TYPE SIMCO 2800 **BORING DEPTH** 21.5 ft
DRILLING METHOD Solid Flight Auger **LOGGED BY** C. Odneal **CHECKED BY** A. AhTye

DEPTH (ft)	SAMPLE TYPE	BLOWS/ft	GRAPHIC LOG	MATERIAL DESCRIPTION	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	REMARKS
0								
				CONCRETE - 6 inches				
				Sandy CLAY - stiff, brown, moist, medium plasticity				
	GB CAL	3-5-12 (17)			105.5	20.4	S = 95 %	
5	SPT	3-7-9 (16)		Very stiff				
10	CAL	4-7-9 (16)		Stiff, increased sand	95.4	16.3	S = 59 %	
15	SPT	4-5-8 (13)						
20	CAL	4-7-8 (15)		Decreased sand	103.8	20.3	S = 91 %	

NOTES:

1. Bottom of boring at 21.5 feet.
2. No groundwater encountered.
3. Boring backfilled with auger cuttings.



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BORING B-3

PAGE 1 OF 2

PROJECT NAME Proposed Aquatic Complex Modernization **PROJECT NUMBER** 240282
PROJECT LOCATION Tranquility, California **SURFACE DESCRIPTION** grass
DATE STARTED 5/13/24 **COMPLETED** 5/13/24 **GROUND ELEVATION** 0 ft
DRILLING CONTRACTOR TECHNICON Engineering Services, Inc. **GROUND WATER LEVEL** 45 ft / Elev -45 ft
DRILL RIG TYPE SIMCO 2800 **BORING DEPTH** 51.5 ft
DRILLING METHOD Solid Flight Auger **LOGGED BY** C. Odneal **CHECKED BY** A. AhTye

DEPTH (ft)	SAMPLE TYPE	BLOWS/ft	GRAPHIC LOG	MATERIAL DESCRIPTION	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	REMARKS
0								
	CAL	3-4-6 (10)		Sandy CLAY (CL) - medium stiff, brown, moist, medium plasticity	99.3	23.5	S = 93 %	
	GB							
5				Very stiff				
	CAL	5-10-18 (28)			103.8	21.5	S = 96 %	
10				Stiff				
	SPT	2-3-6 (9)						
15				Very stiff				
	CAL	6-11-17 (28)			116.0	16.3	S = 101 %	
20				Stiff, increased sand				
	SPT	3-4-5 (9)						
25				Poorly Graded SAND WITH SILT (SP-SM) - medium dense, brown, moist, fine grained				
	CAL	8-13-20 (33)			99.8	14.5	S = 58 %	
30				Grayish black, fine to medium grained				
	SPT	6-11-14 (25)						
35								

(Continued Next Page)



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BORING B-3

PAGE 2 OF 2

PROJECT NAME Proposed Aquatic Complex Modernization

PROJECT NUMBER 240282

PROJECT LOCATION Tranquility, California

SURFACE DESCRIPTION grass

DATE STARTED 5/13/24

COMPLETED 5/13/24

GROUND ELEVATION 0 ft

DRILLING CONTRACTOR TECHNICON Engineering Services, Inc.

GROUND WATER LEVEL 45 ft / Elev -45 ft

DRILL RIG TYPE SIMCO 2800

BORING DEPTH 51.5 ft

DRILLING METHOD Solid Flight Auger

LOGGED BY C. Odneal

CHECKED BY A. AhTye

DEPTH (ft)	SAMPLE TYPE	BLOWS/ft	GRAPHIC LOG	MATERIAL DESCRIPTION	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	REMARKS
35								
	CAL	13-14-25 (39)		Poorly Graded SAND WITH SILT (SP-SM) - dense, gray, fine to coarse grained, trace silt	89.9	6.7	S = 21 %	
40				Sandy CLAY (CL) - very stiff, grayish brown, moist, medium plasticity				
	SPT	6-11-11 (22)						
45				Poorly Graded SAND WITH SILT (SP-SM) - medium dense, brownish gray, moist, fine to medium grained				
	CAL	4-11-18 (29)		Wet	104.7	21.1	S = 97 %	
50								
	SPT	5-8-8 (16)						

NOTES:

1. Bottom of boring at 51.5 feet.
2. Groundwater encountered at 45.0 feet.
3. Boring backfilled with auger cuttings.



TECHNICON Engineering Services, Inc.
4539 N. Brawley Avenue #108
Fresno, California 93722
Telephone: 559.276.9311

BORING B-4

PAGE 1 OF 1

PROJECT NAME Proposed Aquatic Complex Modernization **PROJECT NUMBER** 240282
PROJECT LOCATION Tranquility, California **SURFACE DESCRIPTION** grass
DATE STARTED 5/14/24 **COMPLETED** 5/14/24 **GROUND ELEVATION** 0 ft
DRILLING CONTRACTOR TECHNICON Engineering Services, Inc. **GROUND WATER LEVEL** No groundwater encountered.
DRILL RIG TYPE SIMCO 2800 **BORING DEPTH** 16.5 ft
DRILLING METHOD Solid Flight Auger **LOGGED BY** C. Odneal **CHECKED BY** A. AhTye

DEPTH (ft)	SAMPLE TYPE	BLOWS/ft	GRAPHIC LOG	MATERIAL DESCRIPTION	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	REMARKS
0								
	CAL	3-11-20 (31)		Sandy CLAY (CL) - very stiff, dark brown, moist, medium plasticity	112.2	14.8	S = 83 %	
5	SPT	5-8-11 (19)		Brown, increased sand				
10	CAL	5-10-11 (21)						
	SPT	5-14-13 (27)						
15	SPT	3-6-4 (10)		Silty SAND (SM) - medium dense, brown, moist, fine to medium grained				

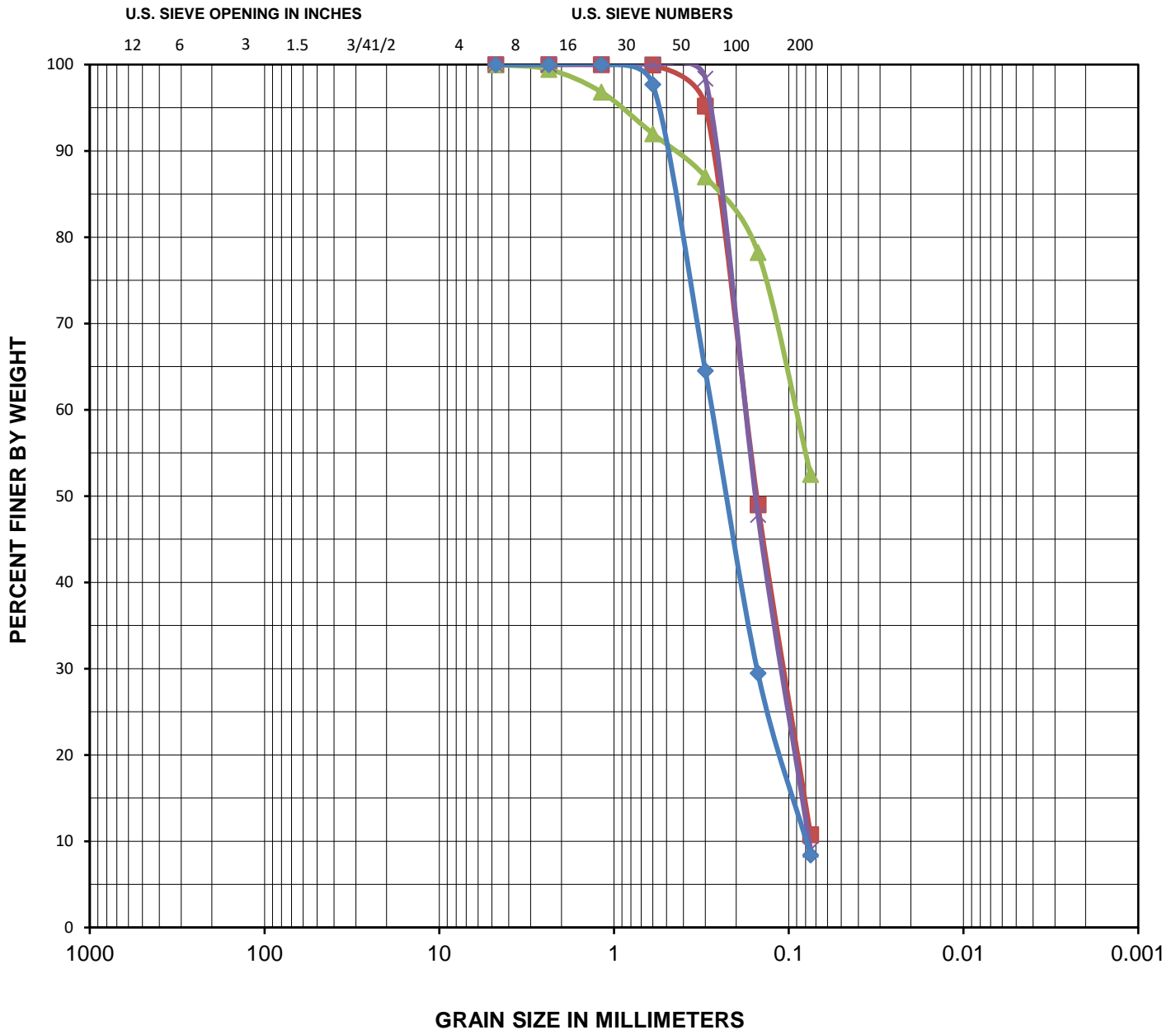
NOTES:

1. Bottom of boring at 16.5 feet.
2. No groundwater encountered.
3. Boring backfilled with auger cuttings.

LABORATORY TESTS

APPENDIX B

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY
		coarse	fine	coarse	medium	fine		



Boring	Depth (ft.)	Sample Description	Passing 3/4"	Passing #4	Passing #200
■ B-1	25	Poorly Graded SAND with Silt (SP-SM)	100.0	100.0	10.7
▲ B-2	0-5	Sandy CLAY (CL)	100.0	100.0	52.5
✕ B-3	30	Poorly Graded SAND with Silt (SP-SM)	100.0	100.0	9.0
◆ B-3	45	Poorly Graded SAND with Silt (SP-SM)	100.0	100.0	8.4

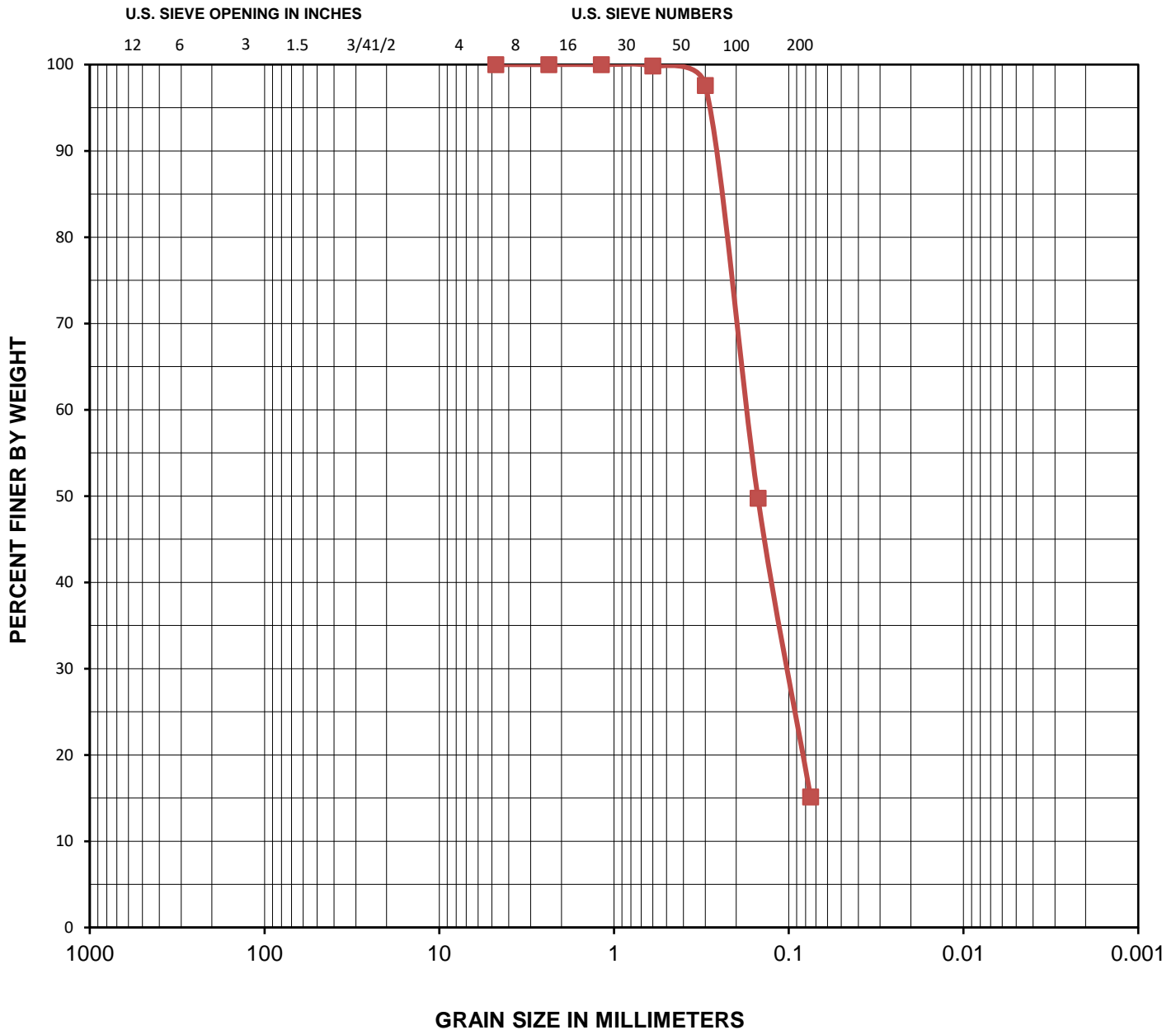
PROJECT NO.: 240282
 LAB TECH: SA
 INPUT BY: SA
 CHECKED BY: SA
 DATE: 6/6/2024
 REVISED: -

SIEVE ANALYSIS

PROPOSED AQUATIC COMPLEX MODERNIZATION
 TRANQUILITY HIGH SCHOOL
 TRANQUILITY, CALIFORNIA



BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY
		coarse	fine	coarse	medium	fine		



Boring	Depth (ft.)	Sample Description	Passing 3/4"	Passing #4	Passing #200
— B-4	15	Silty SAND (SM)	100.0	100.0	15.1

PROJECT NO.: 240282
 LAB TECH:
 INPUT BY: AA
 CHECKED BY: SA
 DATE: 6/6/2024
 REVISED: -

SIEVE ANALYSIS

PROPOSED AQUATIC COMPLEX MODERNIZATION
 TRANQUILITY HIGH SCHOOL
 TRANQUILITY, CALIFORNIA



Boring	Depth (ft.)	Sample Description
B-2	0-5	Sandy CLAY (CL)

Moisture		
Wet Weight (g)	Dry Weight (g)	Water Content (%)
200.0	184	8.7


Soil Specimen		
Mold Weight (g)	Soil + Mold Weight (g)	Soil Weight (g)
363.5	776.5	413.0
Mold Diameter (in)	Mold Height (in)	Mold Volume (ft ³)
4.0	1.0	12.57
Moist Density (pcf)	Dry Density (pcf)	Saturation (%)
124.6	114.6	49.9

Expansion		
Initial Reading (in)	Final Reading (in)	Expansion (in)
0.0000	0.0624	0.0624

Expansion Index, EI	
EI _{measured}	EI ₅₀
62.4	62.3

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
> 130	Very High

Testing performed in general accordance with ASTM D4829

PROJECT NO	240282	EXPANSION INDEX PROPOSED AQUATIC COMPLEX MODERNIZATION TRANQUILITY HIGH SCHOOL TRANQUILITY, CALIFORNIA	
LAB TECH:			
INPUT BY:	AA		
CHECKED BY:	SA		
DATE:	6/6/2024		
REVISED:	-		

Boring	Depth (ft.)	Sample Description
B-3	0-5	Sandy CLAY (CL)

Moisture		
Wet Weight (g)	Dry Weight (g)	Water Content (%)
200.0	181.9	10.0


Soil Specimen		
Mold Weight (g)	Soil + Mold Weight (g)	Soil Weight (g)
366.5	760.5	394.0
Mold Diameter (in)	Mold Height (in)	Mold Volume (ft ³)
4.0	1.0	12.57
Moist Density (pcf)	Dry Density (pcf)	Saturation (%)
118.8	108.1	48.1

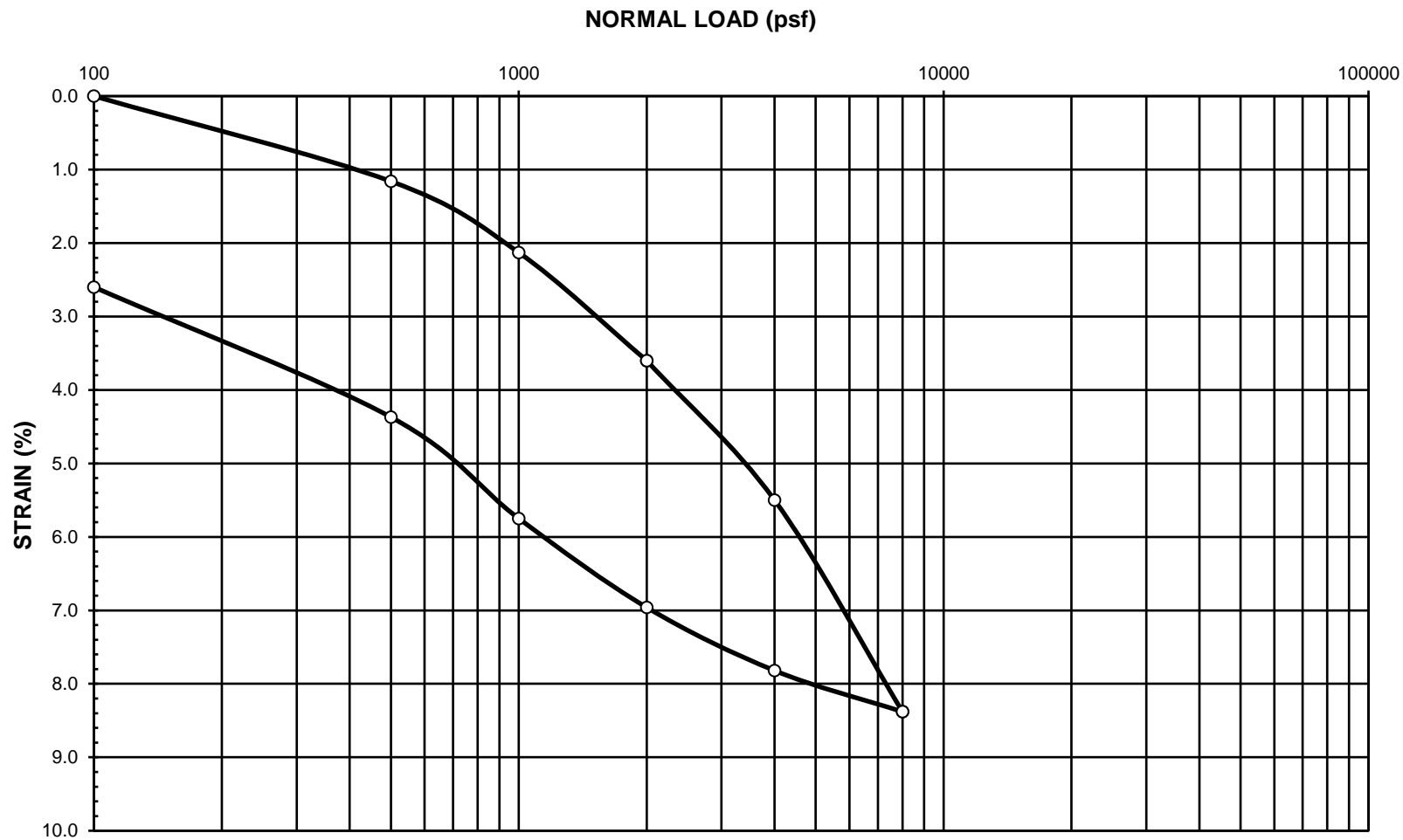
Expansion		
Initial Reading (in)	Final Reading (in)	Expansion (in)
0.0000	0.0987	0.0987

Expansion Index, EI	
EI _{measured}	EI ₅₀
98.7	96.9

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
> 130	Very High

Testing performed in general accordance with ASTM D4829

PROJECT NO	240282	EXPANSION INDEX PROPOSED AQUATIC COMPLEX MODERNIZATION TRANQUILITY HIGH SCHOOL TRANQUILITY, CALIFORNIA	
LAB TECH:			
INPUT BY:	AA		
CHECKED BY:	SA		
DATE:	6/6/2024		
REVISED:	-		



Boring	Depth (ft)	Sample Description
B-3	1.0	Sandy CLAY (CL)

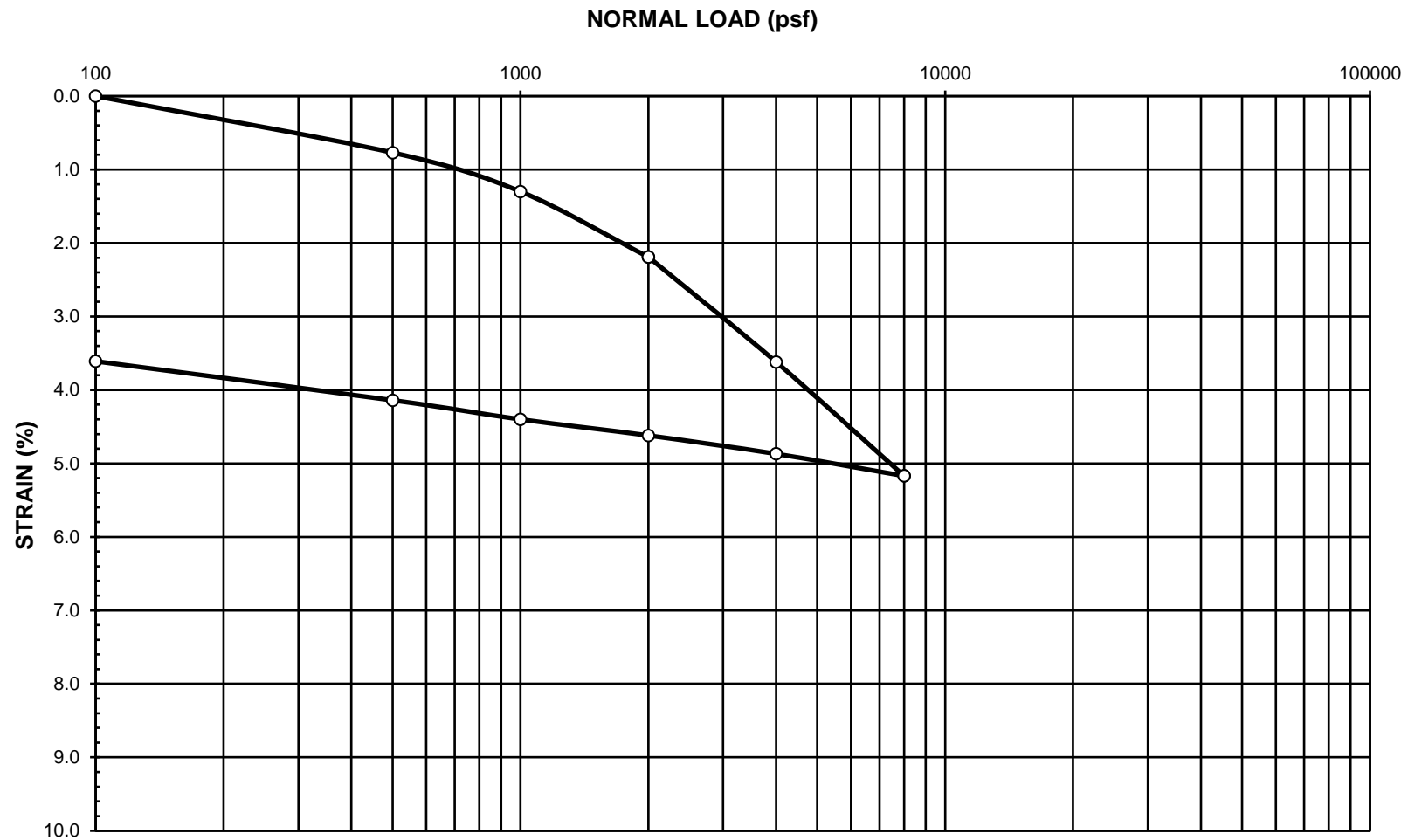
	Sample Diameter (in)	Sample Height (in)	Moisture Content (%)	Dry Density (pcf)
Initial	2.42	1.0000	25.7	97.2
Final	2.42	0.9162	26.0	106.1

PROJECT NO.: 240282
 LAB TECH: SH
 INPUT BY: AA
 CHECKED BY: SA
 DATE: 6/6/2024
 REVISED: -

COLLAPSE POTENTIAL

PROPOSED AQUATIC COMPLEX MODERNIZATION
 TRANQUILITY HIGH SCHOOL
 TRANQUILITY, CALIFORNIA





Boring	Depth (ft)	Sample Description
B-1	5.0	Sandy CLAY (CL)

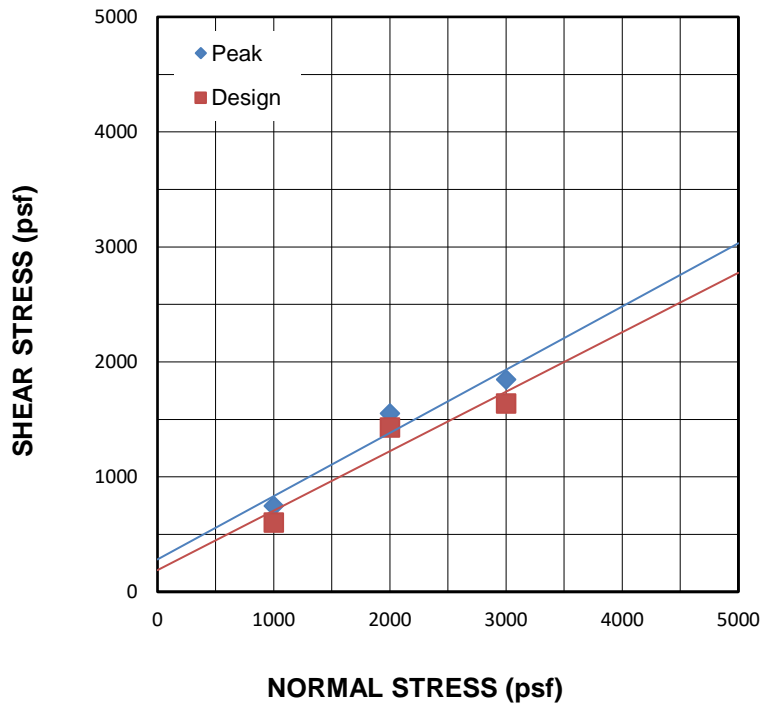
	Sample Diameter (in)	Sample Height (in)	Moisture Content (%)	Dry Density (pcf)
Initial	2.42	1.0000	20.0	106.0
Final	2.42	0.9483	20.6	111.8

PROJECT NO.: 240282
 LAB TECH: SH
 INPUT BY: AA
 CHECKED BY: SA
 DATE: 6/6/2024
 REVISED: -

COLLAPSE POTENTIAL

PROPOSED AQUATIC COMPLEX MODERNIZATION
 TRANQUILITY HIGH SCHOOL
 TRANQUILITY, CALIFORNIA






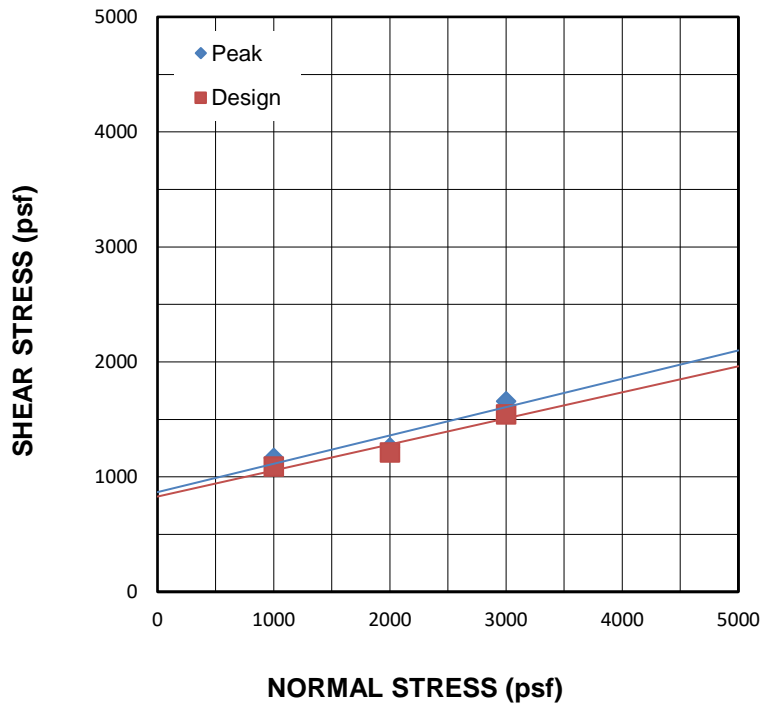
Depth (ft.)	Sample Description
B-2 2	Sandy CLAY (CL)

Initial	Specimen No.	Dry Unit Weight (pcf)	Water Content (%)	Saturation (%)	Area (in ²)	Height (in)
	1	105.5	20.4	95.3	4.60	1.00
	2	105.5	20.4	95.3	4.60	1.00
	3	105.5	20.4	95.3	4.60	1.00
At Test	Specimen No.	Dry Unit Weight (pcf)	Water Content (%)	Saturation (%)	Area (in ²)	Height (in)
	1	106.4	19.93	95.3	4.60	0.991
	2	106.7	18.89	91.0	4.60	0.989
	3	108.2	18.65	93.5	4.60	0.974

Specimen No.	Peak Shear Stress (psf)	Design Shear Stress (psf)	Normal Stress (psf)	Strain Rate (in/min)
1	747.3	603.5	1000	0.002
2	1551.0	1428.2	2000	0.002
3	1847.1	1637.8	3000	0.002

Results	Cohesion (psf)	Friction ϕ (deg)
Peak	282	28.8
Design	189	27.3

PROJECT NO 240282	DIRECT SHEAR PROPOSED AQUATIC COMPLEX MODERNIZATION TRANQUILITY HIGH SCHOOL TRANQUILITY, CALIFORNIA	
LAB TECH: AA INPUT BY: SA CHECKED BY: SA DATE: 6/6/2024 REVISED: -		




Depth (ft.)	Sample Description
B-4 2	Sandy CLAY (CL)

Initial	Specimen No.	Dry Unit Weight (pcf)	Water Content (%)	Saturation (%)	Area (in ²)	Height (in)
	1	112.2	14.8	82.8	4.60	1.00
	2	112.2	14.8	82.8	4.60	1.00
	3	112.2	14.8	82.8	4.60	1.00
At Test	Specimen No.	Dry Unit Weight (pcf)	Water Content (%)	Saturation (%)	Area (in ²)	Height (in)
	1	112.6	19.82	112.1	4.60	0.996
	2	115.3	18.98	115.7	4.60	0.973
	3	117.6	18.22	119.1	4.60	0.951

Specimen No.	Peak Shear Stress (psf)	Design Shear Stress (psf)	Normal Stress (psf)	Strain Rate (in/min)
1	1164.8	1090.2	1000	0.002
2	1257.5	1211.6	2000	0.002
3	1657.7	1543.4	3000	0.002

Results	Cohesion (psf)	Friction ϕ (deg)
Peak	867	13.8
Design	829	12.8

PROJECT NO	240282	DIRECT SHEAR PROPOSED AQUATIC COMPLEX MODERNIZATION TRANQUILITY HIGH SCHOOL TRANQUILITY, CALIFORNIA	
LAB TECH:			
INPUT BY:	AA		
CHECKED BY:	SA		
DATE:	6/6/2024		
REVISED:	-		

Boring	Depth (ft)	Sample Description
B-1	0-5	Sandy CLAY (CL)

--

MINIMUM RESISTIVITY									
---------------------	--	--	--	--	--	--	--	--	--

Water Added (ml)	0	150	250	350	450				
Resistance (ohm)	570,000	4,000	950	993	969				
Resistivity (ohm-cm)*	607,050	4,260	1,012	1,058	1,032				

Box Constant=1.065

Minimum Resistivity (ohm-cm)	1,012
pH	7.83

Years to perforation*	25
-----------------------	----


* Caltrans California Test 643 - Method for Estimating the Service Life of Steel Culverts

--

CHEMICAL ANALYSIS

	<table><tr><th>Soluble Sulfate SO₄-S</th></tr><tr><td>130.1 mg/kg</td></tr><tr><td>134.1 mg/kg</td></tr><tr><td>135 mg/kg</td></tr></table>	Soluble Sulfate SO ₄ -S	130.1 mg/kg	134.1 mg/kg	135 mg/kg	<table><tr><th>Soluble Chloride Cl</th></tr><tr><td>65.6 mg/kg</td></tr><tr><td>65.6 mg/kg</td></tr><tr><td>65.6 mg/kg</td></tr></table>	Soluble Chloride Cl	65.6 mg/kg	65.6 mg/kg	65.6 mg/kg
Soluble Sulfate SO ₄ -S										
130.1 mg/kg										
134.1 mg/kg										
135 mg/kg										
Soluble Chloride Cl										
65.6 mg/kg										
65.6 mg/kg										
65.6 mg/kg										
Average	133.1 mg/kg	65.6 mg/kg								

Testing performed in general accordance with California Test Method Nos. 643, 417, and 422

PROJECT NO.: 240282	<div>CORROSIVITY TESTS</div> <div>PROPOSED AQUATIC COMPLEX MODERNIZATION</div> <div>TRANQUILITY HIGH SCHOOL</div> <div>TRANQUILITY, CALIFORNIA</div>	
LAB TECH:		
INPUT BY: AA		
CHECKED BY: SA		
DATE: 6/6/2024		
REVISED: -		

Boring	Depth (ft)	Sample Description
B-3	0-5	Sandy CLAY (CL)

--

MINIMUM RESISTIVITY

Water Added (ml)	0	150	250	350	450	550	650	750	850
Resistance (ohm)	1,000,000	3,900	337	291	280	266	245	249	253
Resistivity (ohm-cm)*	1,065,000	4,154	359	310	298	283	261	265	269

--

Box Constant=1.065

--

Minimum Resistivity (ohm-cm)	261
------------------------------	-----

pH	7.66
----	------

Years to perforation*	14
-----------------------	----

* Caltrans California Test 643 - Method for Estimating the Service Life of Steel Culverts

--

CHEMICAL ANALYSIS

--


Soluble Sulfate SO ₄ -S
441.6 mg/kg
426.1 mg/kg
428.8 mg/kg

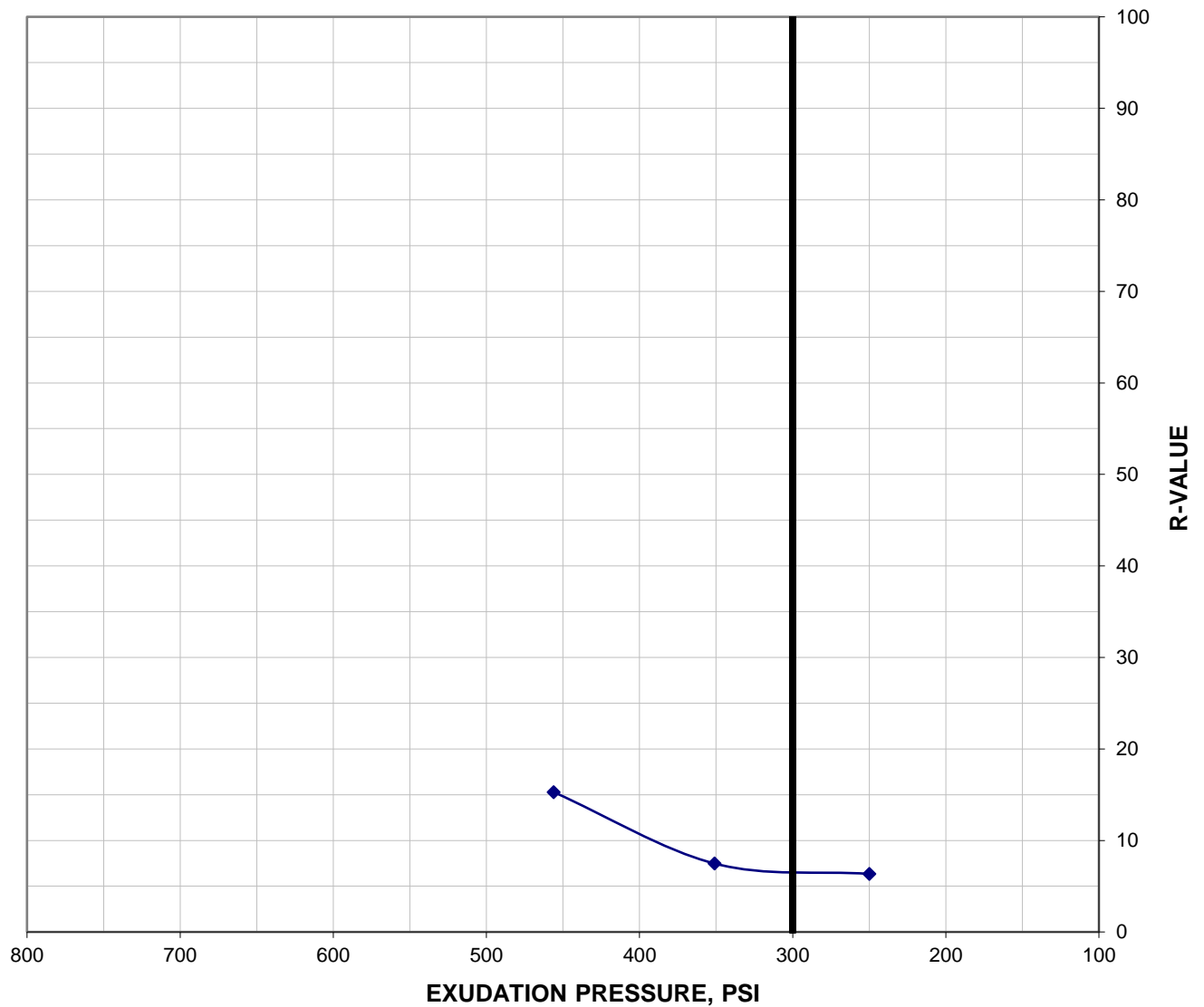
Soluble Chloride Cl
76.2 mg/kg
79.8 mg/kg
79.8 mg/kg

Average	432.2 mg/kg
---------	-------------

78.6 mg/kg

Testing performed in general accordance with California Test Method Nos. 643, 417, and 422


PROJECT NO.: 240282	CORROSIVITY TESTS PROPOSED AQUATIC COMPLEX MODERNIZATION TRANQUILITY HIGH SCHOOL TRANQUILITY, CALIFORNIA	
LAB TECH:		
INPUT BY: AA		
CHECKED BY: SA		
DATE: 6/6/2024		
REVISED: -		

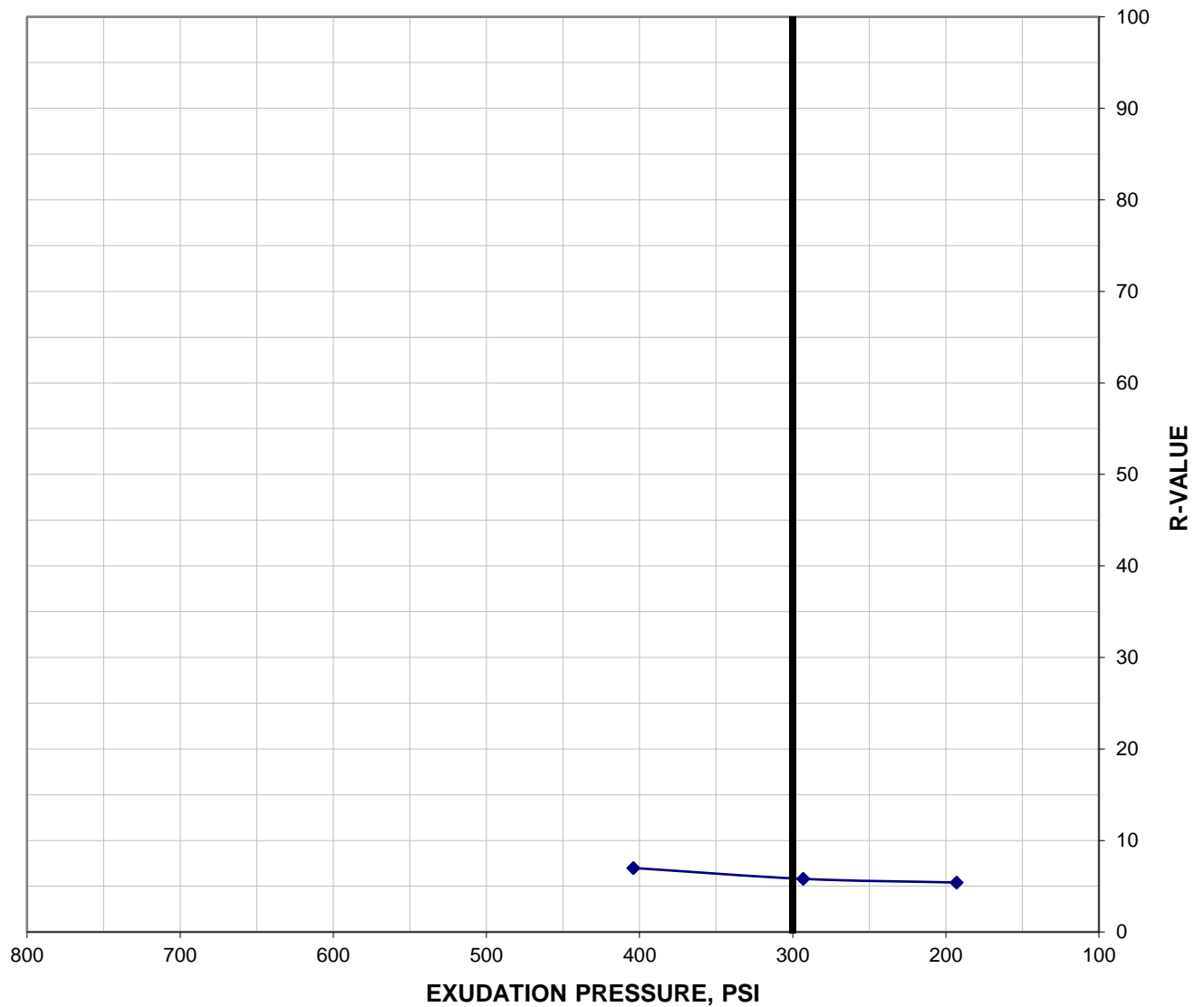


Boring	Depth (ft)	Sample Description
RV-1	0-3	Sandy CLAY (CL)

Specimen	1	2	3
Exudation Pressure (psi)	250	351	456
Moisture Content at Test (%)	20.3	18.8	16.5
Dry Density (pcf)	102.0	105.4	111.2
Expansion Pressure (psf)	0	35	78
R-Value by Stabilometer	6	7	15
R-Value by Expansion Pressure (TI = 4.5)	NA		
R-Value at 300 psi Exudation Pressure	6		

Controlling R-Value	6
---------------------	---


PROJECT NO:	240282	RESISTANCE VALUE	
LAB TECH:	JC		
INPUT BY:	AA	PROPOSED AQUATIC COMPLEX MODERNIZATION	
CHECKED BY:	SA	TRANQUILITY HIGH SCHOOL	
DATE:	6/6/2024	TRANQUILITY, CALIFORNIA	
REVISED:	-		



Boring	Depth (ft)	Sample Description
RV-2	0-3	Sandy CLAY (CL)

Specimen	1	2	3
Exudation Pressure (psi)	193	293	404
Moisture Content at Test (%)	23.6	21.7	18.4
Dry Density (pcf)	96.9	99.8	106.2
Expansion Pressure (psf)	0	74	126
R-Value by Stabilometer	5	6	7
R-Value by Expansion Pressure (TI = 4.5)	NA		
R-Value at 300 psi Exudation Pressure	6		

Controlling R-Value	6
---------------------	---

PROJECT NO:	240282	RESISTANCE VALUE	
LAB TECH:	JC		
INPUT BY:	AA	PROPOSED AQUATIC COMPLEX MODERNIZATION	
CHECKED BY:	SA	TRANQUILITY HIGH SCHOOL	
DATE:	6/6/2024	TRANQUILITY, CALIFORNIA	
REVISED:	-		

USGS DEAGGREGATION SUMMARIES

APPENDIX C

Unified Hazard Tool



Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the [U.S. Seismic Design Maps web tools](#) (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new [USGS Earthquake Hazard Toolbox](#) for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

^ Input

Edition

Dynamic: Conterminous U.S. 2014 (u...

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

36.6453

Time Horizon

Return period in years

2475

Longitude

Decimal degrees, negative values for western longitudes

-120.2529

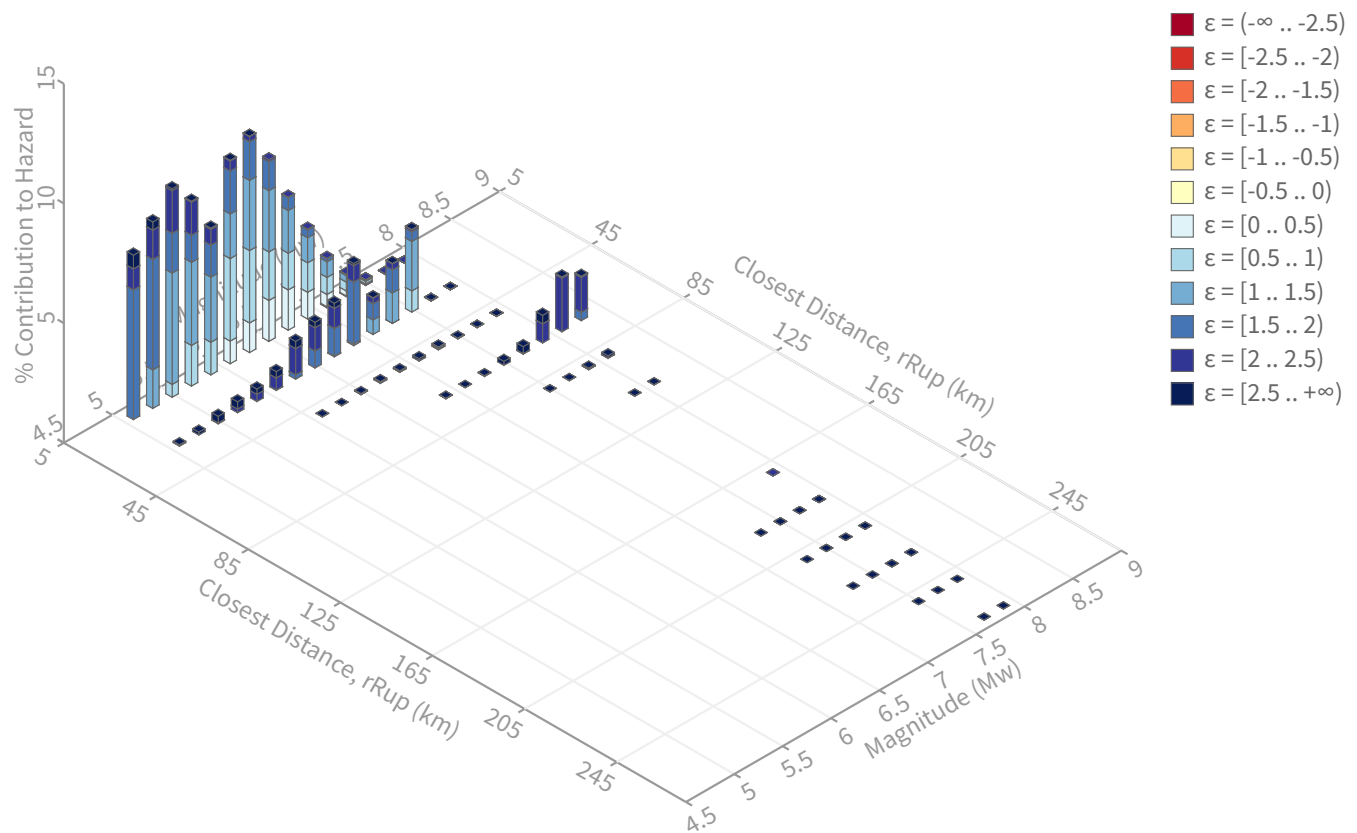
Site Class

259 m/s (Site class D)

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr⁻¹
PGA ground motion: 0.52782838 g

Recovered targets

Return period: 2826.97 yrs
Exceedance rate: 0.00035373563 yr⁻¹

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.09 %

Mean (over all sources)

m: 6.28
r: 17.08 km
ε₀: 1.46 σ

Mode (largest m-r bin)

m: 6.3
r: 10.46 km
ε₀: 1.06 σ
Contribution: 9.02 %

Mode (largest m-r-ε₀ bin)

m: 5.1
r: 8.59 km
ε₀: 1.73 σ
Contribution: 5.41 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↴	Source	Type	r	m	ϵ_0	lon	lat	az	%
UC33brAvg_FM31 (opt)		Grid							40.79
	PointSourceFinite: -120.253, 36.704		7.76	5.83	1.10	120.253°W	36.704°N	0.00	7.64
	PointSourceFinite: -120.253, 36.704		7.76	5.83	1.10	120.253°W	36.704°N	0.00	7.64
	PointSourceFinite: -120.253, 36.713		8.39	5.87	1.16	120.253°W	36.713°N	0.00	4.55
	PointSourceFinite: -120.253, 36.713		8.39	5.87	1.16	120.253°W	36.713°N	0.00	4.55
	PointSourceFinite: -120.253, 36.776		13.13	6.13	1.57	120.253°W	36.776°N	0.00	3.06
	PointSourceFinite: -120.253, 36.776		13.13	6.13	1.57	120.253°W	36.776°N	0.00	3.06
	PointSourceFinite: -120.253, 36.794		14.54	6.20	1.66	120.253°W	36.794°N	0.00	1.65
	PointSourceFinite: -120.253, 36.794		14.54	6.20	1.66	120.253°W	36.794°N	0.00	1.65
UC33brAvg_FM32 (opt)		Grid							40.73
	PointSourceFinite: -120.253, 36.704		7.77	5.83	1.10	120.253°W	36.704°N	0.00	7.64
	PointSourceFinite: -120.253, 36.704		7.77	5.83	1.10	120.253°W	36.704°N	0.00	7.64
	PointSourceFinite: -120.253, 36.713		8.39	5.87	1.17	120.253°W	36.713°N	0.00	4.54
	PointSourceFinite: -120.253, 36.713		8.39	5.87	1.17	120.253°W	36.713°N	0.00	4.54
	PointSourceFinite: -120.253, 36.776		13.13	6.13	1.57	120.253°W	36.776°N	0.00	3.06
	PointSourceFinite: -120.253, 36.776		13.13	6.13	1.57	120.253°W	36.776°N	0.00	3.06
	PointSourceFinite: -120.253, 36.794		14.55	6.20	1.66	120.253°W	36.794°N	0.00	1.65
	PointSourceFinite: -120.253, 36.794		14.55	6.20	1.66	120.253°W	36.794°N	0.00	1.65
UC33brAvg_FM32		System							9.25
	Great Valley 11 [4]		26.11	7.09	1.55	120.455°W	36.489°N	226.03	4.36
	San Andreas (Creeping Section) [6]		68.98	8.14	2.20	120.853°W	36.268°N	232.17	2.19
UC33brAvg_FM31		System							9.23
	Great Valley 11 [4]		26.11	7.09	1.55	120.455°W	36.489°N	226.03	4.36
	San Andreas (Creeping Section) [6]		68.98	8.14	2.20	120.853°W	36.268°N	232.17	2.19

SITE SPECIFIC GROUND MOTION ANALYSIS

APPENDIX D

Site-Specific Ground Motion Analysis (per ASCE 7-16)

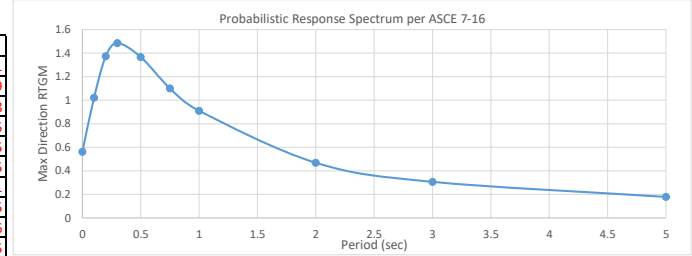
Technicon Engineering Services, Inc.	
Project:	Proposed Aquatic Complex Modernization
Job #:	240282
Date:	6/10/2024
Checked by:	S. Alvarez
S_s	0.967
S_1	0.336
S_{DS}	0.718
PGA_M	0.317
F_a	1.113



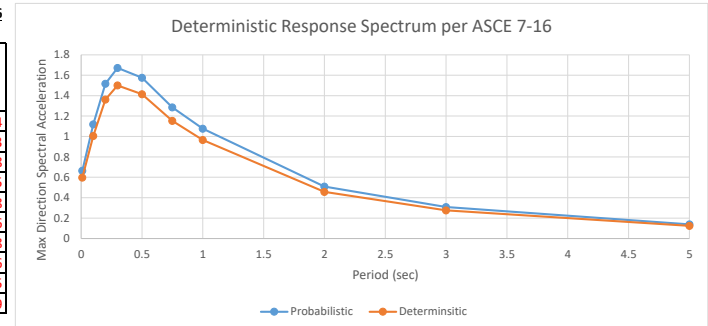
INPUT
OUTPUT
ANALYSIS

1. Use Unified Hazard Tool "raw data" from Hazard Curve & Risk-Targeted Ground Motion Calculator to get "UHGM & RTGM" values
 - a. Plot time vs. adjusted RTGM
2. Input M_w and R_{rup} into NGAW2 Excel worksheet. M_w & R_{rup} can be found with deagg sheet (unified hazard tool) "Mean (over all sources)".
 - a. PS_s Median + 5% damping is 84th – percentile spectral acceleration

		* from RTGM Calculator		Max Dir Scale Factor	Max Dir RTGM (g)
Period (s)		UHGM (g)	RTGM (g)		
0		0.528	0.511	1.1	0.5621
0.1		0.953	0.929	1.1	1.0219
0.2		1.27	1.248	1.1	1.3728
0.3		1.369	1.32	1.125	1.485
0.5		1.218	1.163	1.175	1.366525
0.75		0.946	0.889	1.2375	1.1001375
1		0.745	0.7	1.3	0.91
2		0.373	0.347	1.35	0.46845
3		0.236	0.219	1.4	0.3066
5		0.131	0.119	1.5	0.1785



		Scaling Factor: 0.897176796			
		*From NGA-West2 GMPE Worksheet			
Period (s)	84th- percentile spectral acceleration (+1.σ for 5 % damping)	Max Dir Scale Factor	Max Dir Deterministic SA (prob.)	ASCE 7-16 SECTION 21.2.2 (Det.)	
0.01	0.604507806	1.1	0.664958586	0.596585414	
0.1	1.017773408	1.1	1.119550748	1.00434953	
0.2	1.379452628	1.1	1.51739789	1.361374178	
0.3	1.486143355	1.125	1.671911274	1.5	
0.5	1.340976844	1.175	1.575647792	1.413634638	
0.75	1.038169287	1.2375	1.284734493	1.152633976	
1	0.828123297	1.3	1.076560286	0.965864908	
2	0.377623029	1.35	0.509791089	0.457372736	
3	0.219994822	1.4	0.307992751	0.27632395	
5	0.092432506	1.5	0.138648759	0.124392449	



- ASCE 7-16 Section 21.2.2

If Largest Deterministic Spectral acceleration < 1.5, then scaling by a factor of F_a 1.5.

Table 11.4.1 : Site Class D @ $S_s \geq 1.5$ → $F_a =$ **1.113**

F_a 1.5 → $F_{a,s}$ **1.6695**

- Section 11.4.6 - Design Response Spectrum

$$T_0 = 0.2 \left(\frac{S_{D1}}{S_{DS}} \right)$$

$$\text{equ. 11.4-2: } S_{M1} = S_1 * F_v \rightarrow \mathbf{1.26}$$

$$\text{equ. 11.4-4: } S_{D1} = \left(\frac{2}{3} \right) S_{M1} \rightarrow \mathbf{0.840}$$

$$T_0 \Rightarrow \mathbf{0.234}$$

$$T_s \Rightarrow \mathbf{1.170}$$

- Section 21.3

F_v is taken as 2.4 for $S_1 < 0.2$ or 2.5 for $S_1 > 0.2$

$F_v \Rightarrow \mathbf{2.5}$

S_s	0.967
S_1	0.336
S_{DS} * from seismic design map	0.718
S_{D1} * from section 11.4.6	0.840
T_0	0.234
T_s	1.170

Site-Specific Ground Motion Analysis (per ASCE 7-16) - cont.

Technicon Engineering Services, Inc.	
Project:	Proposed Aquatic Complex Modernization
Job #:	240282
Date:	6/10/2024
Checked by:	S. Alvarez
S_s	0.967
S_1	0.336
S_{D5}	0.718
PGA_M	0.317
F_a	1.113



INPUT
OUTPUT
ANALYSIS

Site-Specific Response Spectra (Section 11.4.6)

Period (T) (sec)	Code-Based - Spectrum Design spectral response acceleration (S_a)	*make sure below applies to period (T) (sec)	80% Code-Based	$S_a = (2/3)(S_{am})$ (prob. Design)	(Sec. 21.4) $T \cdot S_a$
0.01	0.305611571	T less than T_0	0.244489257	0.374733333	0.003747333
0.1	0.471315714		0.377052571	0.681266667	0.068126667
0.2	0.655431429		0.524345143	0.9152	0.18304
0.3	0.718		0.5744	0.99	0.297
0.5	0.718		0.5744	0.911016667	0.455508333
0.75	0.718	$T_0 < T < T_g$; $T = S_{D5}$	0.5744	0.733425	0.55006875
1	0.718		0.5744	0.606666667	0.606666667
2	0.42		0.336	0.3123	0.672
3	0.28	$T > T_g$; $S_a = S_{D1}/T$	0.224	0.2044	0.672
5	0.168		0.1344	0.119	0.672

- Section 21.4 Design Acceleration Parameters

Max S_a between $T = 0.2 - 5$ sec (From Design Spectrum (prob.) graph)

$S_{a,max} \rightarrow 0.99$

$$S_{D5} = 90\% \cdot S_{a,max} \rightarrow 0.891$$

$$S_{M5} = 1.5 \cdot S_{D5} \rightarrow 1.337$$

$V_{s30} < 365$ m/s

Max $T \cdot S_a$ between $T = 1$ sec - 5 sec (From Design Spectrum (prob.) graph)

Max S_a between $T = 1 - 5$ sec $\rightarrow 0.672$

$$S_{D1} \rightarrow 0.672$$

$$S_{M1} = 1.5 \cdot S_{D1} \rightarrow 1.008$$

- Section 21.5.1 - Probabilistic MCE_g Peak Ground Acceleration

Probabilistic PGA from UHGM @ $T = 0$ sec

$$PGA_{prob.} \rightarrow 0.528$$

- Section 21.5.2 - Deterministic MCE_g Peak Ground Acceleration

Deterministic PGA from 84th Spectral Acceleration @ $T = 0.01$ sec

$$PGA \rightarrow 0.605$$

Table 11.8-1: Site Class D @ $PGA = 0.5 \rightarrow F_{PGA} = 1.113$

$$0.5F_{PGA} = 0.5565$$

Use greater of PGA or $0.5F_{PGA}$

Therefore; $PGA_{det.} \rightarrow 0.604507806$

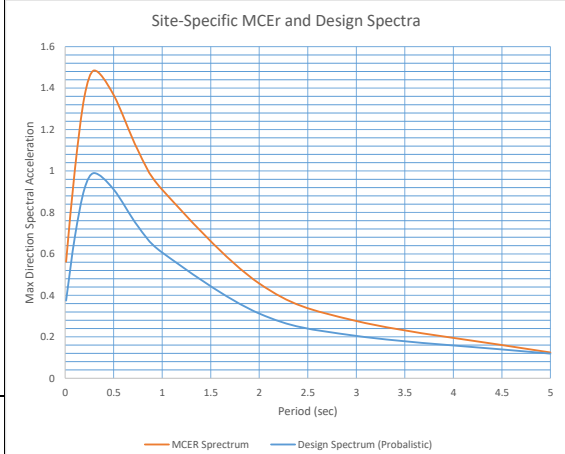
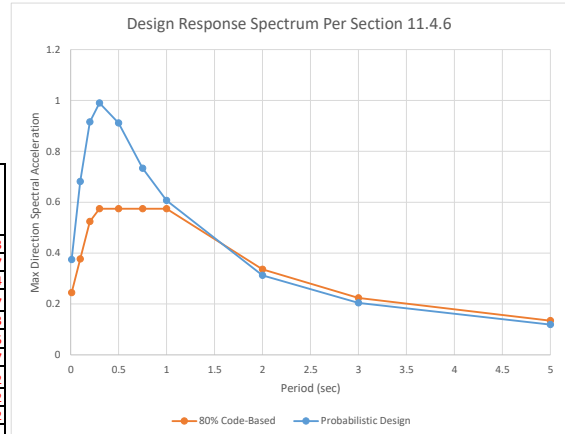
- Section 21.5.3 - Site Specific MCE_g Peak Ground Acceleration

$$PGA_{prob.} \rightarrow 0.528$$

*Take the lesser

$$PGA_{det.} \rightarrow 0.5565$$

$$PGA_{site} \rightarrow 0.528$$



PGA CHECK

From Seismic Design Map: $PGA_M \rightarrow 0.317$

80 % of $PGA_M \rightarrow 0.254$

Site-Specific PGA \rightarrow *Take the greater
 0.528

Final Seismic Design Values	
S_s	0.967
S_1	0.336
S_{M5}	1.337
S_{D5}	0.891
S_{D1}	0.672
S_{M1}	1.008
F_a	1.113
F_v	2.500
PGA_M	0.528

**LIQUEFACTION ANALYSIS AND SEISMICALLY
INDUCED SETTLEMENT CALCULATIONS
APPENDIX E**

Aquatic Complex Modernization
DSA File
DSA App No.

Calc by AA
Checked by SA

Date
Date

6/10/24
6/10/24

Project No: TES 240282
Boring: B-3

Liquefaction analysis is performed following Seed's Procedure, outlined by Seed and Harder (1990), as modified in 1998 NCEER Workshops. Reference Youd et al., 2001

**Includes revisions proposed by Youd (2001)

The induced cyclic stress ratio (CSR) by a given peak ground acceleration (a_{max}) is:

**CSR = (t_{av})/s'_{vo} = 0.65 (s_{vo} /s'_{vo})(a_{max} /g) r_d MSF

where: **Magnitude Scaling Factor, MSF =31.623*(exp(-0.4605*Mw))

**Stress Reduction Factor, r_d =

$$\frac{1.000-0.4113z^{0.5}+0.04052z+0.001753z^{1.5}}{1.00-0.4177z^{0.5}+0.05729z-0.006205z^{1.5}+0.001210z^2}$$

a_{max} = maximum peak acceleration at the ground surface (g's)

g = acceleration of gravity Mw = Moment Magnitude

Rod Length = 1.22 meters above grounds surface

Hammer Efficiency = 88% Emean/E60 = Energy Ratio to correct to standard 60% Energy

Ring Sampler Corr. = 0.65

The cyclic resistance ratio (CRR) is now read directly from the curve for clean sands under level ground conditions based on the corrected SPT value.

This SPT N value is now corrected for earthquake magnitude, fines, energy, overburden pressure, & sampler factors.

The CSR factors in a magnitude scaling factor and a stress reduction coefficient.

Factor of Safety, F_L is:

F_L = CRR / CSR = Uniform CSR necessary to trigger liquefaction/Equivalent, Uniform, earthquake induced CSR

Surcharge = Any surcharge on top of the ground (psf) ¹C_N = 2.2/(1.2+s'_v/P_a)Youd and Idriss 2001 Formula (10)

Hammer
Efficiencies -
Technicon Drilling
Rigs

CME 45	80.0%
CME 55	82.4%
CME 75	87.8%

Emean/E60=		1.467	Sur.=		0		psf		Measured Ground Water Depth =			45		feet		Design Ground Water Depth =			6.7			feet			acc. max =		0.528		g		Earthq. Mw = 6.6			
Depth to Bottom of Layer (ft.)	Boring Diameter (in)	Soil Type	Layer Thickness (ft.)	Total Overburden Press. σ_{vo} (tsf)	Effect. Overburden Press. σ'_{vo} (tsf) at Measured Ground Water Depth	Effect. Overburden Press. σ'_{vo} (tsf) at Design Ground Water Depth	Midpoint Below Ground Surface (m)	Cn	Total Unit Wt. (pcf) at Measured Ground Water Depth	Total Unit Wt. (pcf) at Design Ground Water Depth	Sampler Type 1 = SPT 2=Ca.Mod	Field Blow Count N	α	β	Stress Reduct. Coeff. rd	MSF	Est. % Fines	C_B	C_R	C_S	$C_B C_R C_S$	Corrected Blow Count (N_1) ₆₀	(N_1) _{60CS}	CSR _{7.5} Induced	CRR _{7.5} (Resist. - c.sand)	Factor of Safety F_L	Will It Liquefy?							
3	4	CL	3	0.09	0.09	0.09	0.5	1.70	120	119	2	10	5.000	1.200	0.997	1.51	52.0	1.1	0.75	1.00	0.83	13.5	21.2	0.228	0.231	1.01	ABOVE							
6.7	4	CL	3.7	0.30	0.30	0.29	1.5	1.49	125	115	1	16	5.000	1.200	0.989	1.51	60.0	1.1	0.75	1.20	1.00	35.0	47.0	0.232	LARGE	LARGE	ABOVE							
8	4	CL	1.3	0.45	0.45	0.42	2.2	1.36	125	128	1	16	5.000	1.200	0.983	1.51	60.0	1.0	0.80	1.20	0.96	30.7	41.8	0.238	LARGE	LARGE	NO							
13	4	CL	5	0.64	0.64	0.55	3.2	1.23	120	125	1	8	5.000	1.200	0.976	1.51	60.0	1.0	0.85	1.20	1.02	14.7	22.6	0.258	0.251	0.98	YES							
18	4	SP-SM	5	0.96	0.96	0.72	4.7	1.06	133	135	1	10	2.498	1.048	0.964	1.51	15.0	1.0	0.85	1.20	1.02	15.8	19.1	0.291	0.204	0.70	YES							
23	4	CL	5	1.28	1.28	0.89	6.2	0.92	125	127	1	9	5.000	1.200	0.952	1.51	60.0	1.0	0.95	1.20	1.14	13.9	21.7	0.310	0.238	0.77	YES							
28	4	SP-SM	5	1.57	1.57	1.05	7.8	0.83	105	125	2	33	1.209	1.026	0.941	1.51	11.0	1.0	0.95	1.00	0.95	24.9	26.7	0.318	0.331	1.04	NO							
33	4	SP-SM	5	1.83	1.83	1.21	9.3	0.76	105	125	1	25	0.557	1.017	0.926	1.51	9.0	1.0	1.00	1.20	1.20	33.5	34.6	0.318	LARGE	LARGE	NO							
38	4	SP-SM	5	2.09	2.09	1.36	10.8	0.70	105	125	2	39	0.419	1.015	0.885	1.51	8.5	1.0	1.00	1.00	1.00	26.1	26.9	0.308	0.337	1.09	NO							
43	4	CL	5	2.38	2.38	1.52	12.3	0.65	123	123	1	22	5.000	1.200	0.844	1.51	70.0	1.0	1.00	1.20	1.20	25.1	35.1	0.300	LARGE	LARGE	NO							
48	4	SP-SM	5	2.67	2.60	1.66	13.9	0.61	113	113	2	29	0.557	1.017	0.804	1.51	9.0	1.0	1.00	1.00	1.00	16.9	17.8	0.294	0.189	0.64	YES							
51.5	4	SP-SM	3.5	2.91	2.70	1.76	15.2	0.60	113	113	1	16	0.557	1.017	0.769	1.51	9.0	1.0	1.00	1.20	1.20	16.8	17.6	0.288	LARGE	LARGE	NO							

Aquatic Complex Modernization
DSA File
DSA App No.

Calc by AA
Checked by SA

Date
6/10/24
Date
6/10/24

Project No: TES 240282
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Liquefaction analysis is performed following Seed's Procedure, outlined by Seed and Harder (1990), as modified in 1998 NCEER Workshops. Reference Youd et al., 2001

**Includes revisions proposed by Youd (2001)

The induced cyclic stress ratio (CSR) by a given peak ground acceleration (a_{max}) is:

****CSR = $(t_{av})/s'_{vo} = 0.65 (s_{vo} / s'_{vo})(a_{max} / g) r_d$ MSF**

where: ****Magnitude Scaling Factor, MSF =31.623*(exp(-0.4605*Mw))**

****Stress Reduction Factor, r_d =**

$\frac{1.000-0.4113z^{0.5}+0.04052z+0.001753z^{1.5}}{1.00-0.4177z^{0.5}+0.05729z-0.006205z^{1.5}+0.001210z^2}$

a_{max} = maximum peak acceleration at the ground surface (g's)

g = acceleration of gravity

Mw = Moment Magnitude

Rod Length = **1.22** meters above grounds surface

Hammer Efficiency = **88%** Emean/E60 = Energy Ratio to correct to standard 60% Energy

Ring Sampler Corr. = **0.65**

The cyclic resistance ratio (CRR) is now read directly from the curve for clean sands under level ground conditions based on the corrected SPT value.

This SPT N value is now corrected for earthquake magnitude, fines, energy, overburden pressure, & sampler factors.

The CSR factors in a magnitude scaling factor and a stress reduction coefficient.

Settlement = e * Layer thickness in inches (Figure 9 1997 NCEER)

Surcharge = Any surcharge on top of the ground (psf)

$^1C_N = (P_a/s'_{vo})^{0.5}$ Youd and Idriss 2001 Formula (9)

Emean/E60=		1.467	Sur.=		0	psf	Measured Ground Water Depth =			45	feet	Design Ground Water Depth =			6.7	feet	acc. max =			0.528	g	Earthq. Mw = 6.6		
Depth to Bottom of Layer (ft.)	Boring Diameter (in)	Soil Type	Layer Thickness (ft.)	Total Overburden Press. σ_{vo} (tsf)	Effect. Overburden Press. σ'_{vo} (tsf) at Measured Ground Water Depth	Effect. Overburden Press. σ'_{vo} (tsf) at Design Ground Water Depth	Midpoint Below Ground Surface (ft)	Cn	Total Unit Wt. (pcf) at Measured Ground Water Depth	Total Unit Wt. (pcf) at Design Ground Water Depth	Sampler Type 1 = SPT 2=Ca.Mod	Field Blow Count N	Stress Reduct. Coeff. r_d	MSF	Est. % Fines	$C_B C_R C_s$	Corrected Blow Count $(N_1)_{60}$	ΔN	$(N_1)_{60cs}$	CSR _{7.5} Induced	Factor of Safety F_L	ϵ (Only if FS<1.3) (%)	Settlement, inches	
3	4	CL	3	0.09	0.09	0.09	0.5	1.70	120	119	2	10	0.997	1.51	52.0	0.83	13.5	4.2	17.6	0.228	1.01	-	ABOVE	
6.7	4	CL	3.7	0.30	0.30	0.29	1.5	1.49	125	115	1	16	0.989	1.51	60.0	1.00	35.0	4.8	39.8	0.232	LARGE	-	ABOVE	
8	4	CL	1.3	0.45	0.45	0.42	2.2	1.36	125	128	1	16	0.983	1.51	60.0	0.96	30.7	4.8	35.4	0.238	LARGE		NONE	
13	4	CL	5	0.64	0.64	0.55	3.2	1.23	120	125	1	8	0.976	1.51	60.0	1.02	14.7	4.8	19.5	0.258	0.98	0.280	0.2	
18	4	SP-SM	5	0.96	0.96	0.72	4.7	1.06	133	135	1	10	0.964	1.51	15.0	1.02	15.8	1.2	17.0	0.291	0.70	0.350	0.2	
23	4	CL	5	1.28	1.28	0.89	6.2	0.92	125	127	1	9	0.952	1.51	60.0	1.14	13.9	4.8	18.7	0.310	0.77	0.350	0.2	
28	4	SP-SM	5	1.57	1.57	1.05	7.8	0.83	105	125	2	33	0.941	1.51	11.0	0.95	24.9	0.9	25.8	0.318	1.04	-	0.0	
33	4	SP-SM	5	1.83	1.83	1.21	9.3	0.76	105	125	1	25	0.926	1.51	9.0	1.20	33.5	0.8	34.3	0.318	LARGE	-	NONE	
33	4	SP-SM	5	2.09	2.09	1.36	10.8	0.70	105	125	2	39	0.885	1.51	8.5	1.00	26.1	0.7	26.9	0.308	1.09	-	0.0	
43	4	CL	5	2.38	2.38	1.52	12.3	0.65	123	123	1	22	0.844	1.51	70.0	1.20	25.1	5.6	30.7	0.300	LARGE	-	NONE	
48	4	SP-SM	5	2.67	2.60	1.66	13.9	0.61	113	113	2	29	0.804	1.51	9.0	1.00	16.9	0.8	17.7	0.294	0.64	0.350	0.2	
51.5	4	SP-SM	3.5	2.91	2.70	1.76	15.2	0.60	113	113	1	16	0.769	1.51	9.0	1.20	16.8	0.8	17.5	0.288	LARGE	-	NONE	

Total Settlement 0.8
May be off by 0.1 inches due to rounding

APPENDIX NO. 2



GEOTECHNICAL & ENVIRONMENTAL ENGINEERING ▲ CONSTRUCTION TESTING & INSPECTION

April 29, 2025

TES No. 240282.002

Ms. Blanca Mercedes
Golden Plains Unified School District
22000 Nevada Street
San Joaquin, California 93660
Email: blancamercedes@maasco.com

Project: Proposed Aquatic Complex Modernization
Tranquility High School
6052 Juanche Avenue
Tranquility, California

Subject: Supplemental Pier Design Recommendations

Dear Ms. Mercedes:

TECHNICON Engineering Services, Inc. (TECHNICON) prepared this letter as a supplement to the Geotechnical Investigation and Geologic Hazards Evaluation Report (GIR) associated with the proposed Tranquility High School Aquatic Complex Modernization project located in Tranquility, California. **TECHNICON** previously prepared a GIR for the Aquatic Complex Modernization (reference file TES No. 240282.001, dated June 12, 2024).

PROJECT DESCRIPTION

The project involves the continued design and construction of the aquatic complex modernization project at the Tranquility High School in Tranquility, California. Additional explanation and design criteria for pole/pier foundation design was recommended by the structural engineer for foundation design purposes. The following recommendations should supersede the pier foundation recommendations in the referenced report.

PIER FOUNDATIONS

Allowable Vertical Axial Capacity and Settlements

Structures such as light poles, signs, canopies, etc., can be supported by pier foundations. Should design incorporate the use of pier foundations, Table 1 provides expressions for the allowable and ultimate axial capacity using friction to resist axial loads. If the design of the pier foundations includes end bearing to resist axial loads, the design may utilize a bearing capacity of 2,000 psf for static loading (D.L. + long term L.L.). The end bearing capacity may be increased 50 percent for total combined loading (D.L. + L.L. + transient loading, such as wind or seismic).

CORPORATE OFFICE ▲ 4539 N. Brawley Avenue #108, Fresno, CA 93722 ▲ P 559.276.9311 ▲ F 559.276.9344

MERCED OFFICE ▲ 2345 Jetway Drive, Atwater, CA 95301 ▲ P 209.384.9300 ▲ F 209.384.0891

www.technicon.net

TABLE 1
ALLOWABLE AXIAL CAPACITY

	Frictional Resistance for Vertical Loads in Compression (lbs)
Static Loading	$25 DL^2 + 1,255 DL$
Total Combined Loading	$30 DL^2 + 1,675 DL$
Unfactored Ultimate Capacity	$45 DL^2 + 2,510 DL$

Note: 1) D is pier diameter in feet and L is embedment length in feet.

2) The allowable uplift resistance would be 70 percent of the compressional resistance.

The total settlement of friction piers designed in accordance with the above recommendations should be less than 0.002 times the pier diameter in inches. If design incorporates end bearing to resist axial loading, the estimated settlement would increase to approximately 0.018 times the pier diameter in inches. The concrete mix and reinforcement for drilled pier/caisson foundations should be designed by the project structural engineer.

Lateral Resistance

The allowable passive pressure to resist lateral loads on isolated piers may utilize the values presented in Table No. 1806A.02 of the 2022 California Building Code (CBC). Based on the on-site soils encountered, class of material 5 (Sandy Clay) should be utilized which yields a lateral bearing pressure of 100 psf per foot of embedment.

For isolated poles to support buildings, a lateral bearing pressure equal to two times the tabulated value, as expressed above, can be used in accordance with Section 1806A.3.4 of the 2022 CBC.

Passive resistance should be neglected in the first 12 inches, unless surrounded by hardscape. The passive pressure only considers soil strength. Tolerable pier deflection may govern the design lateral resistance. If provided with pier geometry, lateral load, and loading eccentricity, **TECHNICON** can provide the estimated pier head deflection.

CONSTRUCTION OBSERVATION AND TESTING

It is recommended that a representative of **TECHNICON** observe the earthwork and foundation phases of work to determine that the subsurface conditions are compatible with those used in the analysis and design. **TECHNICON** can conduct the necessary field testing and provide results on a timely basis so that action necessary to remedy indicated deficiencies can be taken in accordance with the plans and specifications. Upon completion of the work, a written summary of our observations, field testing, and conclusions regarding the conformance of the completed work to the intent of the plans and specifications will be provided. This additional service is not part of this current contractual agreement.

LIMITATIONS

The conclusions and recommendations presented in this letter/report are based on the information provided regarding the proposed construction, and the results of our current field testing along with field and laboratory investigation from the referenced GIR, combined with interpolation of the subsurface conditions between boring locations. The nature and extent of the variations between borings may not become evident until construction. If variations or undesirable conditions are encountered during construction, our firm should be notified promptly so that these conditions can be reviewed and our recommendations reconsidered where necessary. The unexpected conditions frequently require additional expenditures for proper construction of the project. **TECHNICON** will not assume any responsibility for errors or omissions if the final extent and depth of earthwork is not determined by our firm at the time of construction due to said variations or undesirable conditions encountered. If the proposed construction is relocated or redesigned, or if there is a substantial lapse of time between the submission of our report and the start of work at the site, or if conditions have changed due to natural causes, or construction operations at or adjacent to the site, the conclusions and recommendations contained in this report should be considered invalid unless the changes are reviewed and our conclusions and recommendations modified or approved in writing. Such conditions may require additional field and laboratory investigations to determine if our conclusions and recommendations are applicable considering the changed conditions or time lapse.

CLOSING

We appreciate the opportunity to provide geotechnical engineering services to Golden Plains Unified School District during the design phase of this project. If you have any questions regarding the information presented herein, or if we can be of further assistance, please contact our office at your convenience.

Respectfully submitted,
TECHNICON Engineering Services, Inc.


Adam AhTye, PE
Geotechnical Engineering Manager




Salvador Alvarez, PE, GE
Geotechnical Engineer



AA:km

APPENDIX NO. 3

CALGREEN CODE SUBMITTAL CHECKLIST

PURPOSE

K-12 schools and community college projects submitted to the Division of the State Architect (DSA) as a single project, increments, or pre-checked (PC) applications, must comply with the Title 24, Part 11, California Green Building Standards Code (CALGreen). This form lists the mandatory measures required for CALGreen compliance, as applicable, and must be submitted with the construction documents. Applicable CALGreen mandatory measures, including applicable worksheets and declaration statements, are required to be included in the construction documents.

CALGreen Section 306 Voluntary Measures encourages building practices that improve public health, safety, and general welfare by promoting the use of building concepts which minimize the building's impact on the environment and promote a more sustainable design. Chapter 5 Nonresidential Mandatory Measures that are not adopted by DSA-SS, and Nonresidential Voluntary Measures indicated in CALGreen Appendix A5, Divisions A5.1 through A5.5, are voluntary. Including voluntary measures into the project is encouraged; however, DSA will not review the compliance of voluntary measures included in the project.

Documentation demonstrating compliance with CALGreen Division 5.2 – ENERGY EFFICIENCY, which requires compliance of the project with the current edition of Title 24, Part 6, California Energy Code, is not addressed herein. All applicable energy forms must be included in the Project per California Energy Code requirements.

INSTRUCTIONS

For project submission, provide the CALGreen Mandatory Measures that are required for the project, submit the completed form DSA 403-C, completed applicable worksheets, and applicable signed declaration statements with the project documents.

If the project does not require compliance with CALGreen mandatory measures addressed herein check "NO" in the box at the top of the checklist. If compliance with CALGreen mandatory measures addressed herein is required, check "YES" in the box at the top of the checklist and proceed to fill out the checklist as to the applicable measures.

All clear fields must be filled with a sheet number and/or a specification section number indicating the location where required items are included in the construction documents. Regulatory requirements not applicable to the scope of work shall be indicated "N/A". Do not provide input to shaded boxes in the checklist.

The design professional in responsible charge is responsible for CALGreen compliance and completion of form DSA 403-C. Prior to project submittal, compliance of mandatory measures supported by the requisite information shall be verified. Any questions related to the applicability of a listed item to the specific project scope should be clarified with DSA staff at a pre-application meeting or prior to project registration.

Plan review will not commence until this completed checklist is submitted, and any applicable worksheets and declaration statements are signed and included in the construction documents.

APPLICABILITY

CALGreen regulatory requirements for public schools and community colleges consist of the scoping provisions in CALGreen Chapter 3, Section 301.4 and the nonresidential mandatory measures indicated as adopted by DSA-SS in Chapter 5 Matrix Adoption Table below.

CALGREEN CODE SUBMITTAL CHECKLIST**CHAPTER 5 – NONRESIDENTIAL MANDATORY MEASURES FOR K-12 SCHOOLS AND COMMUNITY COLLEGES**

COMPLIANCE WITH THE CALGREEN MANDATORY MEASURES INDICATED HEREIN IS REQUIRED FOR THE PROJECT		Yes <input type="checkbox"/> No <input type="checkbox"/>
CALGREEN SECTION – TITLE		Provide: Sheet(s) # in Plans Specification Section Complete as indicated or “N/A” if not applicable.
5.105 - DECONSTRUCTION AND REUSE OF EXISTING STRUCTURES		
Section 5.105.1 ¹ and 5.105.2 Reuse of existing building. Provide WS-3 in construction documents, see EXHIBIT A below.		
5.106 – SITE DEVELOPMENT		
Section 5.106.4.2 Bicycle parking.		
<input type="checkbox"/>	Section 5.106.4.2.1 Student bicycle parking.	N/A
<input type="checkbox"/>	Section 5.106.4.2.2 Staff bicycle parking.	N/A
Section 5.106.5.6 Electric vehicle charging.		
<input type="checkbox"/>	Section 5.106.5.6.1 Electric vehicle capable spaces.	N/A
<input type="checkbox"/>	Section 5.106.5.6.2 or 5.106.5.6.3 Electric vehicle charging stations (EVCS).	N/A
Section 5.106.8 Light pollution reduction.		Sheet E001, E202 and 401+
Section 5.106.10 Grading and paving.		C5.01
Section 5.106.12 Shade trees.		
<input type="checkbox"/>	Section 5.106.12.1 Surface parking area shade tree calculation. Enter calculated percentage.	N/A
<input type="checkbox"/>	Section 5.106.12.2 Landscape area shade tree calculation. Enter calculated percentage.	N/A
<input type="checkbox"/>	Section 5.106.12.3 Hardscape area shade tree calculation. Enter calculated percentage.	N/A
5.303 INDOOR WATER USE		
Section 5.303.3 Water conserving plumbing fixtures.		

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Section 5.303.3.1 Water closets.	N/A
Section 5.303.3.2.1 Wall mounted urinals.	N/A
Section 5.303.3.2.1 Floor mounted (or other) urinals.	N/A
Section 5.303.3.3.1 Single showerheads.	P0.00
Section 5.303.3.3.2 Multiple showerheads serving one shower.	N/A
Section 5.303.3.4.1 Nonresidential lavatory faucets.	N/A
Section 5.303.3.4.2 Kitchen faucets.	N/A
Section 5.303.3.4.3 Wash fountains.	N/A
Section 5.303.3.4.4 Metering faucets.	N/A
Section 5.303.3.4.5 Metering faucets for wash fountains.	N/A
Section 5.303.3.4.6 Pre-rinse spray valve.	N/A
5.304 OUTDOOR WATER USE	
Section 5.304.6 Outdoor potable water use.	
Section 5.304.6.1 Newly constructed landscapes. Submit DSA 1-L and enter "Y".	Y
Section 5.304.6.2 Rehabilitated landscapes. Submit DSA 1-L and enter "Y".	Y
5.407 WATER RESISTANCE AND MOISTURE MANAGEMENT	
Section 5.407.1 Weather protection.	075419
Section 5.407.2 Moisture control.	
Section 5.407.2.1 Sprinklers (landscape irrigation).	328400
Section 5.407.2.2.1 Exterior door protection for primary exterior entries.	N/A
Section 5.407.2.2.1 Flashing.	076200
5.408 CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING	
Section 5.408.1 Construction waste management.	
Section 5.408.1.1 Construction waste management plan.	017419
Section 5.408.1.2 Waste management company.	N/A

CALGREEN CODE SUBMITTAL CHECKLIST

Section 5.408.1.3 Waste stream reduction alternative.	
SECTION 5.409 LIFE CYCLE ASSESSMENT	
Section 5.409.2 Whole building life cycle assessment ¹ . Provide signed declaration statement and worksheet in drawings, see EXHIBIT B below.	N/A
Section 5.409.3 Product GWP compliance ¹ – prescriptive compliance. Provide signed declaration statement in drawings, see EXHIBIT C below.	N/A
5.410 BUILDING MAINTENANCE AND OPERATION	
Section 5.410.1 Recycling by occupants.	011813
5.504 POLLUTANT CONTROL	
Section 5.504.3 Covering of duct openings and protection of mechanical equipment during construction.	N/A
Section 5.504.4 Finish material pollutant control.	
Section 5.504.4.1 Adhesives sealants and caulks.	079200
Section 5.504.4.3 Paints and coatings.	099114 099124 +
Section 5.504.4.4 Carpet systems.	N/A
Section 5.504.4.5 Composite wood products.	N/A
Section 5.504.4.6 Resilient flooring systems.	N/A
Section 5.504.4.7 Thermal insulation.	072100
Section 5.504.4.8 Acoustical ceilings and wall panels.	N/A
Section 5.504.5.3 Filters (Merv 13).	N/A
5.505 INDOOR MOISTURE CONTROL	
Section 5.505.1 Indoor moisture control per CBC Sections 1202 (Ventilation) and Chapter 14 (Exterior Walls).	N/A
5.506 INDOOR AIR QUALITY	
Section 5.506.1 Outside air delivery per California Energy Code Section 120.1, and Chapter 4 of CCR Title 8	N/A
Section 5.506.3 Carbon dioxide monitoring.	
Section 5.506.2 Carbon Dioxide (CO ₂) monitoring in classrooms (energy manage control system).	N/A
Section 5.506.3 Carbon Dioxide (CO ₂) monitoring in classrooms (standalone).	N/A

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SECTION 5.507 ENVIRONMENTAL COMFORT		
Section 5.507.4 Acoustical control.		
Section 5.507.4.1 Exterior noise transmission prescriptive method (detail STC rating)		N/A
Section 5.507.4.2 Exterior noise transmission performance method (document acoustical analysis)		N/A
Section 5.507.4.3 Interior sound transmission (detail STC rating)		N/A
SECTION 5.508 OUTDOOR AIR QUALITY		
Section 5.508.1 Ozone depletion and greenhouse gas reductions		
Section 5.508.1.1 Chlorofluorocarbons (CFCs).		N/A
Section 5.508.1.1 Halons.		N/A

FOOTNOTES:

1: New construction projects consisting of a total floor area is 50,000 sq. ft. or greater must complete either Section 5.509.2 or Section 5.409.3. Alteration or addition projects consisting of a total floor area of 50,000 sq. ft. or greater must complete Section 5.105.2, 5.409.2, or 5.409.3

Professional in General Responsible Charge Declaration Statement:

As the Professional in General Responsible Charge, I have reviewed the Project Plans and affirm that the documentation submitted is in compliance with the requirements of CALGreen (Title 24, Part 11). Required documentation, applicable worksheets and signed declaration statements are included in the construction documents on the drawing sheet indicated in the completed form. I will verify that all work shown on the DSA approved construction documents necessary for compliance to CALGreen mandatory measures is completed in construction and prior to occupancy.

Signature:  Date: 04/30/2025

Print Full Name: Antonio Pavone

REFERENCES:

California Green Building Standards Code Title 24 Part 11, Chapter 6 Referenced Organizations and Standards
California Energy Code Title 24 Part 6
CCR Title 8, Division 1, Chapter 4