

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
- C. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
- D. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
- E. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled "GENERAL NOTES" for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.2 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 and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.

2. Section 011000 "Summary" for limits on use of Project site.
3. Section 013300 "Submittal Procedures" for submitting surveys.
4. 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.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 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.

1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 1. Prior to submitting cutting and patching plan, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit two copies signed by land surveyor.
- F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 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. 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, 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. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.

- i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. 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. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 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.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- 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.

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, 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to 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. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using 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 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.

3.4 FIELD ENGINEERING

- A. Identification: Owner 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. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect 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.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: 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.
- 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 the best possible results. 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.
- 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: Where possible, 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.
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. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, 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 according to 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 minimize 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 and Masonry: 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. 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 minimize 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.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- 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 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 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 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. General: 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, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- 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 according to 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 in Finished Areas: 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 as required.
- 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. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
- C. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
- D. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
- E. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled "GENERAL NOTES" for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 048100 "Unit Masonry" for disposal requirements for masonry waste.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. 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.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 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.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- C. 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.
- D. Qualification Data: For waste management coordinator and refrigerant recovery technician.

- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Refrigerant Recovery: Comply with requirements in Section 024119 "Selective Demolition" for refrigerant recovery submittals.

1.7 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.
- B. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 024119 "Selective Demolition."
- C. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- D. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. 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. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. 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. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. 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. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. 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 the 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. The following list of items include but are not limited to the only materials and components that potentially could be salvaged and recycled.
1. Demolition Waste:
 - a. Asphalt paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Wood studs.
 - g. Wood joists.
 - h. Plywood and oriented strand board.
 - i. Wood paneling.
 - j. Wood trim.
 - k. Structural and miscellaneous steel.
 - l. Rough hardware.
 - m. Roofing.

- n. Insulation.
- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.
- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring.
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- nn. Switchgear and panelboards.
- oo. Transformers.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. 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.

m. 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 the entire duration of the Contract.
 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. 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. Salvaging is not a project requirement. While items have been identified for salvage potential, the salvage of the items listed is voluntary. All demolition waste shall be removed from the site and disposed in manner complying with local and state Authorities Having Jurisdiction (AHJ).
- B. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- C. Salvaged Items for Reuse in the Work: Salvage items for reuse and 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.
- D. Salvaged Items for Sale and Donation: Not permitted on Project site.
- E. Salvaged Items for Owner's Use: Salvage items for Owner's use and 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.
- F. General: Recycle paper and beverage containers used by on-site workers.
- G. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- H. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to 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.

3.3 RECYCLING DEMOLITION WASTE

- A. Recycling is not a project requirement. While items have been identified for recycle potential, the recycle of the items listed is voluntary. All demolition waste shall be removed from the site and disposed in manner complying with local and state Authorities Having Jurisdiction (AHJ).
- B. Asphalt Paving: Grind asphalt to maximum 4-inch size.
 1. Crush asphaltic concrete paving and screen for use as general fill.
- C. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- D. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Pulverize concrete to maximum 4-inch size.
 2. Crush concrete and screen to use as satisfactory soil for fill or subbase.
- E. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 1. Pulverize masonry to maximum 4-inch size.
 2. Clean and stack undamaged, whole masonry units on wood pallets.
- F. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- G. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- J. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

- K. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- L. Conduit: Reduce conduit to straight lengths and store by material and size.
- M. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.4 RECYCLING CONSTRUCTION WASTE

- A. Recycling is not a project requirement. While items have been identified for recycle potential, the recycle of the items listed is voluntary. All demolition waste shall be removed from the site and disposed in manner complying with local and state Authorities Having Jurisdiction (AHJ).
- B. 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.
- C. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements for use of clean sawdust as organic mulch.
- D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements for use of clean ground gypsum board as inorganic soil amendment.
- E. Paint: Seal containers and store by type.

3.5 DISPOSAL OF WASTE

- A. General: 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. Except as 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. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.
- D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
- C. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
- D. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
- E. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled "GENERAL NOTES" for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.2 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. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
 - 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.

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 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section.
 5. Submit testing, adjusting, and balancing records.
- 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.
 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 will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, 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.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. 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 shall state that each item has been completed or otherwise resolved for acceptance.
 2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 3. Submit pest-control final inspection report.
 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 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.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- 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.
 2. Organize items applying to each space by major element, including categories for ceiling, 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.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. PDF electronic file. Architect will return annotated file.

1.9 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. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- 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.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, 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. 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.
 - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - i. 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.
 - j. Remove labels that are not permanent.
 - k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

- 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - p. Leave Project clean and ready for occupancy.
 - C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
 - D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- 3.2 REPAIR OF THE WORK
- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
 - B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
- C. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
- D. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
- E. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled "GENERAL NOTES" for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.2 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. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.

2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 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.

1.4 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 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 by email to Architect. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect 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 will return copy with comments.
 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 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, loose-leaf 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.

1.6 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 shall 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 according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

CONSTRUCTION DOCUMENTS
SPECIFICATIONS
ISSUED FOR CONSTRUCTION

CAMINO REAL WORK FORCE CTR
RENOVATION & EXPANSION PROJ.

OPERATION AND
MAINTENANCE DATA
017823

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
- C. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
- D. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
- E. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled "GENERAL NOTES" for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.2 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. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit one PDF copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one PDF copy 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.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one PDF copy of each submittal.
- E. Reports: Submit written report 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.

1.4 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 sets 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. 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. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as PDF copy.

1.6 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, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as PDF copy.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 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 copy.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 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

PART 3 - EXECUTION

END OF SECTION 017839

SECTION 019100

BUILDING SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Owner's Project Requirements and Basis-of-Design documentation are included by reference for information only.

1.2 SUMMARY

- A. Section Includes:
 - 1. General requirements for coordinating and scheduling commissioning.
 - 2. Commissioning meetings.
 - 3. Commissioning reports.
 - 4. Use of test equipment, instrumentation, and tools for commissioning.
 - 5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
 - 6. Commissioning tests and commissioning test demonstration.
 - 7. Adjusting, verifying, and documenting identified systems and assemblies.
- B. Related Requirements
 - 1. Section Special Procedures – LEED Certification
 - 2. Section Closeout Procedures
 - 3. Section Operation and Maintenance Documentation
 - 4. Section Special Conditions for All Mechanical Work
 - 5. Section Testing, Adjusting and Balancing
 - 6. Section Electrical Systems Commissioning

1.3 DEFINITIONS AND ABBREVIATIONS

- A. Definitions set forth in the General Conditions, AIA Document A201, are applicable to this Section. In addition, the following definitions shall apply to the terms used in this section.
 - 1. **“Acceptance Phase”** – Phase of construction after start-up and initial checkout when functional performance tests, O&M documentation review, and training occurs.
 - 2. **“Approval”** – Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
 - 3. **“Architect / Engineer (A/E)”** – The prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer / engineer, plumbing designer / engineer, and the electrical designer / engineer.
 - 4. **“Basis of Design”** – The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions, and methods chosen to meet the design intent.
 - 5. **“Commissioning Authority (CxA)”** – An independent agent, not otherwise associated with the A/E team members or the Contractor, though he / she may be hired as a

- subcontractor to them. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role like the CM. The CxA is part of the Construction Manager (CM) team or shall report directly to the CM.
6. **“Commissioning Plan”** – An overall plan, developed before or after bidding, that provides the structure, schedule, and coordination planning for the commissioning process.
 7. **“Contract Documents”** – The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).
 8. **“Contractor”** – The general contractor or authorized representative.
 9. **“Control System”** – The central building energy management control system.
 10. **“Construction Manager (CM)”** – The Owner’s representative in the day-to-day activities of construction. In general, the construction management services contractor (CM) is hired by the owner to assist the government in the overall management of the project including supervising and on-site managing authority over a project’s construction. The General Contractor reports to the CM. The CM is the Owner’s on-site representative.
 11. **“Data-logging”** – Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data-loggers separate from the control system.
 12. **“Deferred Functional Tests”** – FPT’s that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.
 13. **“Deficiency”** – A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
 14. **“Design Intent”** – A dynamic document that provides the explanation of the ideas, concepts, and criteria are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.
 15. **“Design Narrative”** or **“Design Documentation”** – Sections of either the Design Intent or Basis of Design.
 16. **“Factory Testing”** – Testing of equipment on-site or at the factory by factory personnel with an Owner’s representative present.
 17. **“Field Installation Verification (FIV)”** – Verification of all installed systems for compliance to plans and specification. These inspections are to be described in detail in the commissioning plan. Primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels, gages in place, balancing devices in place, etc.).
 18. **“Functional Performance Test (FPT)”** – Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system’s sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) must be completed prior to commencing the FPT. TAB’s primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. FPT’s are performed after Field Installation Verification (FIV) and Operational Performance Tests (OPT) are complete.
 19. **“General Contractor (GC)”** – The prime contractor for this project. Generally, refers

to all the GC's subcontractors as well. Also, referred to as the Contractor in some contexts.

20. **"Indirect Indicators"** – Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
 21. **"Manual Test"** – Using hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
 22. **"Monitoring"** – The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
 23. **"Non-Compliance"** – see Deficiency
 24. **"Non-Conformance"** – see Deficiency
 25. **"Operational Performance Test (OPT)"** – Verification of proper start-up of all equipment and systems to be commissioned. These tests are to be described in detail in the commissioning plan.
 26. **"Over-written Value"** – Writing over a sensor value in the control system to see the response of a system (e.g. changing the outside air temperature value from 50 F to 75 F to verify economizer operation). See also "Simulated Signal."
 27. **"Owner-Contracted Test"** – Tests paid for by the Owner outside the GC's contract and for which the CxA does not oversee. These tests will not be repeated during the functional performance testing.
 28. **"Phased Commissioning"** – Commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order to minimize the total construction time.
 29. **"Project Manager (PM)"** – The contracting and managing authority for the owner over the design and/or construction of the project; a staff position.
 30. **"Sampling"** – Operational or functional testing only a fraction of the total number of identical or near identical pieces of equipment. Refer to Part 3 Execution for details.
 31. **"Seasonal Performance Tests"** – FPT that are deferred until the system(s) will experience conditions closer to their design conditions.
 32. **"Simulated Condition"** – Condition that is created for the purpose of testing the response of a system (e.g. applying a hair blower to a space sensor to see the response in a VAV box).
 33. **"Simulated Signal"** – Disconnecting a sensor and using a signal generator to send an amperage, resistance, or pressure to the transducer and DDC system to simulate a sensor value.
 34. **"Specifications"** – The construction specifications of the Contract Documents.
 35. **"Startup"** – The initial starting or activating of dynamic equipment, including executing OPT's.
 36. **"Subs"** – The subcontractors to the GC who provide and install building components and systems.
 37. **"Test Procedures"** – the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.
 38. **"Trending"** – Monitoring using the building control system.
 39. **"Vendor"** – Supplier of equipment.
 40. **"Warranty Period"** – Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.
- B. Abbreviations. The following are common abbreviations used in the Specifications and in the Commissioning Plan.
1. A/E: Architect and design engineers.
 2. CxA: Commissioning Authority

3. CC: Controls Contractor
4. CM: Construction Manager (the Owner's representative)
5. Cx: Commissioning
6. Cx Plan: Commissioning Plan document
7. DB: Design Build Contractor
8. EC: Electrical Contractor
9. FIV: Field Installation Verification
10. FPT: Functional Performance Test
11. GC: General Contractor (Prime)
12. O & M: Operation and Maintenance
13. MC: Mechanical Contractor
14. OPT: Operational Performance Test
15. PM: Project Manager (of the Owner)
16. Subs: Subcontractors to the General
17. TAB: Test and Balance Contractor

1.4 QUALITY ASSURANCE

- A. Commissioning Agent Qualifications: The Firm and/or the designated Commissioning Agent shall have a minimum of (5) years' experience in providing Total Building Commissioning Services and shall be regularly employed as a Commissioning Provider. The Firm and/or designated Commissioning Agent shall have been the principal Commissioning Agent on a least three (3) comparable projects that have been successfully completed within the previous five (5) years.
- B. The Commissioning Agent shall have current engineering knowledge and extensive hands-on field experience regarding building systems; the physical principles of building systems performance; building systems start-ups, test and balance, functional performance testing, and troubleshooting; operation and maintenance procedures; and the building design and construction process.
- C. The Commissioning Firm and/or the designated Commissioning Agent shall have certifications from one of the following industry organizations or a recognized and established approved equal.
 1. CBCP – Certified Building Commissioning Professional – Association of Energy Engineers (AEE)
 2. CCP – Certified Commissioning Professional – Building Commissioning Association (BCxA)
 3. CPMP – Certified Process Management Professional – ASHRAE
 4. CxA – Certified Commissioning Authority – AABC Commissioning Group (ACG)
 5. NEBB CP – Building Certified Professional Certification – National Environmental Balancing Bureau (NEBB)
 6. QCxP – University of Wisconsin-Madison Certification
 7. Or an approved Commissioning Firm directed by the Owner.

1.5 SYSTEM DESCRIPTION

- A. Commissioning:
 1. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance, and the warranty period with actual

verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment start-up, control system calibration, point-to-point check out, testing and balancing, performance testing, and owner/operator training.

2. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - a. Perform commissioning in accordance with the criteria and requirements set forth in the USGBC LEED v4 rating system.
 - b. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by the installing contractors.
 - c. Verify and document proper performance of equipment and systems.
 - d. Verify that O&M documentation left on site is complete.
 - e. Verify that the owner's operating personnel are adequately trained.
- B. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.
- C. Systems to be commissioned: The following systems shall be commissioned in this project.
 1. Division 26 Electrical Systems
 - a. Interior and exterior lighting systems
 - b. Lighting systems controls
 - c. Emergency Lighting system
 2. Flush Plan for EQ 3.2 (applicable for LEED projects)

1.6 COORDINATION

- A. Commissioning Team:
 1. Commissioning Authority (CxA)
 2. Owner's Project Manager (PM)
 3. Designated representative of the Owner's Construction Management firm (CM)
 4. Design Build Contractor (DB or Contractor)
 5. Architect
 6. Design Engineers (particularly the mechanical engineer)
 7. Mechanical Contractor (MC)
 8. Electrical Contractor (EC)
 9. TAB representative (TAB)
 10. Controls Contractor (CC)
 11. Other installing contractors or suppliers of equipment
 12. Owner's building or plant operator/engineer
- B. Management. The CxA is hired by the Design Build Contractor. The CxA directs and coordinates the commissioning activities and the reports to the owner. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
- C. Scheduling.
 1. The CxA will work with the CM according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the CM for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning

process.

2. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. As construction progresses more detailed schedules are developed by the CxA.

1.7 COMMISSIONING PROCESS

- A. Commissioning Plan. A draft Commissioning Plan shall be developed by the CxA and will be provided at the scoping meeting. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CxA will update the plan which is then considered the "final" plan, though it will continue to evolve and expand as the project progresses. The final commissioning plan is binding on the Contractor. The Specifications will take precedence over the Commissioning Plan.
- B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during design and construction and the general order in which they occur.
 1. Commissioning tasks during design include: evaluating scope and contract, develop specifications and commissioning plans, perform design reviews, assist with preparation of design documents through construction documents as dictated by scope.
 2. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
 3. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending to plan, scope, coordinate, schedule future activities, and resolve problems.
 4. Equipment documentation is submitted to the CxA during normal submittals, including detailed startup procedures.
 5. The CxA works with the subs in developing startup plans and startup documentation formats, including providing the subs with FIV and OPT checklists as a reference of items to be verified by the CxA.
 6. In general, the checkout and performance verifications proceeds from simple to complex; from component level to equipment to systems and intersystem levels with FIV and OPT checklists being completed before functional performance testing. The CxA shall provide field installation inspection for each system and subsystem covered in the scope of work for this project and provide an installation observation report weekly to the General Contractor / Construction Manager. The report shall cover any installation deficiencies from plans and specifications.
 7. The Subs perform startup and initial checkout. The CxA documents that the startup was completed according to the approved plans. This shall include the CxA witnessing startup of selected equipment.
 8. The CxA develops specific equipment and system functional performance test procedures. The Subs review the procedures.
 9. The procedures are executed by the Subs under the direction of and documented by the CxA.
 10. Items of non-compliance in material, installation, or setup are corrected at the Sub's expense and the system retested.
 11. The CxA reviews the O&M documentation for completeness.
 12. Commissioning is completed before Substantial Completion.
 13. The CxA reviews, pre-approves, and coordinates the training provided by the Subs and verifies that it was completed.

1.8 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the plumbing contractor reside in Division 22, the mechanical contractor, TAB, and controls contractor are in Division 23 and those of the electrical contractor in Division 26.
- B. All Parties
1. Assist in the development of the Final Commissioning Plan
 2. Follow the Final Commissioning Plan
 3. Attend commissioning scoping meeting and additional meetings as necessary.
- C. Architect (of A/E)
1. Construction and Acceptance Phase
 - a. Attend the commissioning scoping meeting and selected commissioning team meetings.
 - b. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
 - c. Provide any design narrative documentation requested by the CxA.
 - d. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
 - e. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
 2. Warranty Period: coordinate resolution of design non-conformance and design deficiencies identified during warranty period commissioning.
- D. Mechanical and Electrical Designers/Engineers (of the A/E)
1. Construction and Acceptance Phase
 - a. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.
 - b. Provide any design narrative and sequences documentation requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings, or equipment documentation is not sufficient for writing detailed testing procedures.
 - c. Attend commissioning scoping meetings and other selected commissioning team meetings.
 - d. Participate in the resolution of system deficiencies identified during commissioning according to the contract documents.
 - e. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
 - f. From the Contractors red line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the chilled and hot water, condenser water, domestic water, steam, and condensate systems; supply, return, and exhaust air systems, and emergency power system.
 - g. Review the FIV and OPT checklists for major pieces of equipment for sufficiency prior to their use.
 - h. Review the FPT procedure forms for major pieces of equipment for sufficiency prior to their use.
 2. Warranty Period: Participate in the resolution of non-compliance, non-conformance,

and design deficiencies identified during the warranty period commissioning.

- E. Commissioning Authority (CxA): The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving, non-conformance, or deficiencies, but ultimately that responsibility resides with the GC and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document the performance – that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out, and functionally test equipment and systems, except for specific testing with portable data loggers, which shall be supplied and installed by the CxA.
- F. Construction Manager – Owner’s Representative (CM)
1. Construction and Acceptance Phase
 - a. Facilitate the coordination of the commissioning work by the CxA, and, with the GC and CxA, ensure that commissioning activities are being scheduled into the master schedule.
 - b. Review the final Commissioning Plan – Construction Phase.
 - c. Attend commissioning scoping meetings and other selected commissioning team meetings.
 - d. Perform the normal review of Contractor submittals.
 - e. Furnish a copy of all construction documents, addenda, change orders, and approved submittals and shop drawings related to commissioned equipment to the CxA.
 - f. Review and approve the functional performance test procedures submitted by the CxA prior to testing
 - g. When necessary, observe and witness FIV, OPT, FPT of selected equipment.
 - h. Review commissioning progress and deficiency reports.
 - i. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
 - j. Assist the CxA in coordinating the training of owner personnel.
 2. Warranty Period: Assist the CxA as necessary in the seasonal or deferred testing and deficiency corrections required by the specifications.
- G. Owner's Project Manager (PM)
1. Construction and Acceptance Phase
 - a. Manage the contract of the A/E and of the GC
 - b. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the Commissioning Plan
 - c. Provide final approval for the completion of the commissioning work.
 2. Warranty Period: Ensure that any seasonal or deferred testing and deficiency issues are addressed.
- H. Design Build / General Contractor (DB/GC)
1. Construction and Acceptance Phase
 - a. Facilitate the coordination of the commissioning work by the CxA, and with the GC and CxA ensure that commissioning activities are being scheduled into the master schedule.
 - b. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.

- c. A representative shall attend the commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process
- d. Coordinate the training of owner personnel.
- e. Prepare the O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
2. Warranty Period
 - a. Ensure that Subs execute seasonal or deferred functional performance testing.
 - b. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
3. Plumbing, Mechanical, TAB, Controls, Electrical Contractor/s
 - a. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.
 - b. Contractors shall provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment.
 - c. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.
 1. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
 2. The Commissioning Agent may request further documentation necessary for the commissioning process.
 3. This data request may be made prior to normal submittals.
 - d. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review and approval.
 - e. Provide limited assistance to the CxA in preparing a full start-up and initial checkout plan using manufacturer's start-up procedures. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CxA for review. Refer to Section 018100 for further details on start-up plan preparation.
 - f. Perform all completed start-up and system operational checkout procedures in the presence of the CxA.
 - g. Address current A/E punch list items before functional testing.
 - h. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.
 - i. Perform functional performance testing under the direction of the CxA for specified equipment in this section. Assist the CxA in interpreting the monitoring data, as necessary.
 - j. Correct deficiencies (difference between specified and observed performance) as interpreted by the CxA, CM and A/E and retest the equipment.
 - k. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 - l. Provide training of the Owner's operating personnel as specified.
 - m. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
4. Warranty Period

1. Correct deficiencies and make necessary adjustments to O&M manual and as-built drawings for applicable issues identified in any seasonal testing.
- I. Equipment Supplier
 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 2. Assist in equipment testing per agreements with Subs.
 3. Include all special tools, instruments, and software required for testing equipment according to these Contract Documents in the base bid pricing, except for stand-alone data-logging provided by the CxA.
 4. Review test procedures for equipment installed by factory representatives.
 5. Ensure that any seasonal or deferred testing and deficiency issues are addressed during the warranty period.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and DDC system in Division 23, except for equipment specific to and used by TAB in their contractor responsibilities.
- B. Special equipment, tools, instruments, software, (only available from vendor specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone data-logging equipment that may be used by the CxA.
- C. Data-logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: temperature sensors and digital thermometers shall have an accuracy of $\pm 0.7^\circ$ F with a resolution of 0.1° F. Water Pressure sensors shall have an accuracy of $\pm 2\%$ of reading. All instruments shall be calibrated annually.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Scoping Meeting. Within 60 days of commencement of construction, the CxA will schedule, plan, and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Draft Commission Plan to its "final" version, which will also be distributed to all parties.

- B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with the particular Subs.

3.2 REPORTING

- A. The CxA will provide regular reports to the CM or PM, depending on the management structure, with increasing frequency as construction and commissioning progresses. Standard forms are provided and referenced in the Commissioning Plan.
- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.3 SUBMITTALS

- A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation that the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequence of operation, O&M data, performance data, any performance test procedures, control drawings, user interface graphics for each system, and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.
- B. The CxA will review submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The CxA will notify the CM, PM, or A/E as requested of items missing or areas that are not in conformance with Contract Documents and which require resubmission.
- C. The CxA may request additional design narrative from the A/E and Controls Contractor depending on the completeness of the design intent documentation and sequences provided with the specifications.
- D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review them.

3.4 FIELD INSTALLATION VERIFICATION AND OPERATIONAL PERFORMANCE TESTS

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.3, Systems to be commissioned.

- B. General. FIV's and OPT's are important to ensure that the equipment and systems are hooked-up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full FIV checkout. No sampling strategies are used. FIV's and OPT's for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for start-up of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. The contractor is responsible to perform the start-up procedures of selected equipment in the presence of the CxA.
1. The CxA develops the FIV and OPT checklists and procedures. These checklists indicate required procedures to be executed as part of start-up and initial checkout of the systems and the party responsible for their execution.
 2. These checklists and tests are provided by the CxA to the Contractor for reference during the construction process.
 3. The subcontractor responsible for the purchase of the equipment assists in the development of the full start-up plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The full start-up plan (at a minimum) shall consist of the following:
 - a. The CxA's OPT checklist
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals.
 - c. The manufacturer's normally used filed checkout sheets.
 4. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
 5. The full start-up procedures and the approval form may be provided to the CM for review and approval, depending on management protocol.
- D. Controls System Verification
1. The operation of all control system components shall be verified in the presence of the CxA.
 2. All procedures used shall be fully documented on the OPT checklists clearly referencing the procedures followed and written documentation of initial, intermediate, and final results.
 3. All control point OPT tests shall be verified through the graphic front end software.
 4. All sensors and analog inputs shall be calibrated by manufacturer's standard procedures and to project calibration tolerances.
 5. All analog outputs, actuators, and valves shall be ranged for correct action to the control signal.
- E. Execution of FIV and OPT Procedures.
1. The CxA shall perform regular FIV's throughout the construction period.
 2. Four weeks prior to start-up, the Subs and vendors schedule start-up and checkout with the CM, GC, and CxA. The performance of start-up and checkout are directed and executed by the Sub or vendor in the presence of the CxA.
 3. The CxA shall observe the start-up procedures for each piece of primary equipment.
- F. Deficiency issue log.

1. The CxA shall provide a periodic commissioning issue log clearly listing any deficiencies or areas of concern from any FIV or OPT.
2. The issue log shall be provided to the CM for distribution to the appropriate parties for review, response, and action. All actions and results will be listed on the issue log for future reference (i.e. nothing is ever deleted).
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.5 PHASED COMMISSIONING

- A. The project may require start-up and initial checkout to be executed in phases. This phasing will be planned and scheduled in a coordination meeting of the CxA, CM, mechanical, TAB, controls, and the GC. Results will be added to the master and commissioning schedules.

3.6 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. The general list of equipment to be commissioned is as specified herein.
Objective and Scope
 1. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional tests will identify areas of deficient performance so they can be corrected, improving the operation, and functioning of the systems.
 2. In general, each system should be operated through all modes of operation (seasonal, occupied, un-occupied, warm-up, cool-down, part and full load,) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- C. Development of Test Procedures
 1. Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test, shall provide limited assistance to the CxA in developing the procedures review (answer questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment, and warranty protection. The CxA may submit the tests to the A/E for review, if requested.
 2. The CxA shall review owner-contracted, factory testing or required owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
 3. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
- D. Test Methods
 1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities,

or by stand-alone data loggers. The CxA may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the CM. This may require a change order and adjustment in charge to the owner. The CxA will determine which method is most appropriate for tests that do not have a method specified.

2. Sampling Multiple identical pieces of non-life-safety or otherwise non-critical equipment with identical factory configured control sequences may be functionally tested using sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference.
- E. Coordination and Scheduling
1. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the start-up of all equipment and systems. The CxA will schedule functional tests through the CM, GC, and affected Subs. The CxA shall direct, witness, and document the functional testing of all equipment and systems. The Subs shall execute the tests.
 2. In general, functional testing is conducted after FIV's and OPT's have been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and de-bugged before functional testing of air related or water related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting, individual systems has been achieved, the interface or coordinated responses between systems is checked.
- F. Test Equipment. Refer to Part 2 – Products for test equipment requirements.
- G. Problem Solving. The CxA will recommend solutions to problems found, however, the burden of responsibility to solve, correct, and re-test problems is with the GC, Subs, and A/E.
- H. Deferred Testing. If any check or test cannot be completed due to the building structure, required occupancy condition, or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

3.7 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

- A. Documentation. The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the CM for review and approval and to the Subs for review. The CxA will include the filled out forms in the O&M manuals.
- B. Non-Conformance
1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the CM on the standard commissioning issues log.
 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will

- not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM.
4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 1. If the deficiency can be easily corrected it shall be corrected and the commissioning shall proceed.
 2. The CxA reschedules the test and the test is repeated.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible or the repair will take more than one hour:
 1. The deficiency shall be documented on the issue log or the test check sheet with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
 2. Resolutions are made at the lowest management level possible.
 3. The CxA documents the resolution process.
 4. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 5. Cost of re-testing.
 - a. The cost for the Sub to re-test a OPT or FPT, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for re-testing costs shall be negotiated with the GC.
 - b. For a deficiency identified, not related to any pre-functional checklist or start-up fault, the following shall apply: The CxA and CM will direct the re-testing of the equipment once at no charge to the GC for their time. However, the CxA's and CM's time for a second re-test will be charged to the GC, who may choose to recover costs from the responsible Sub.
 - c. The time for the CxA and CM to direct any re-testing required because a specific FIV or OPT item, reported to have been successfully completed, but determined during functional testing to be faulty, will be back charged to the GC, who may choose to recover costs from the party responsible.
 6. The contractor shall respond in writing to the CxA and CM at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 7. The CxA retains the original non-conformance forms until the end of the project.
 8. Any required re-testing by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.
- C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CM or PM.
- D. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the CM, if necessary. The CxA recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed copy to the CxA and the contractor.

3.8 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals

1. The specific content and format requirements for the standard O&M manuals are detailed in Section 01 78 00. Special requirements for the controls contractor and TAB contractor shall be as specified in Div 23.
2. CxA Review. Prior to substantial completion, the CxA shall review the O&M manuals, documentation, and final as-built drawings for systems that were commissioned to verify compliance with the Specifications. The CxA will communicate deficiencies in the manuals to the CM, PM, A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the CM, PM, or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Commissioning Final Report

1. Final Report Details. The final commissioning report shall include an executive summary, LEED commissioning statement sheet, list of participants, and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the FIV, OPT, and FPT completed check sheets. The report shall also include all issue logs and commissioning communication.
2. Other documentation will be retained by the CxA.

3.9 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
- B. The CxA shall be responsible for overseeing and reviewing the content and adequacy of the training of Owner personnel for commissioned equipment and systems.
 1. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. All training methods shall include a classroom lecture and an actual operational demonstration of start-up, tear down, and maintenance procedures, as applicable and appropriate. A sample of elements contained in the plan is as follows:
 - a. Equipment covered
 - b. Intended audience
 - c. Location of training
 - d. Objectives
 - e. Subjects covered
 - f. Duration of training on each subject
 - g. Instructor name, company, and qualifications
 2. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.
 3. The CxA develops an overall training plan and coordinates and schedules, with the GC and CM, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the CM using standard form. The CM also signs the approval form.

CONSTRUCTION DOCUMENTS

CAMINO REAL WORK FORCE CTR

BUILDING SYSTEMS

SPECIFICATIONS
ISSUED FOR CONSTRUCTION

RENOVATION & EXPANSION PROJ.

COMMISSIONING

019100

05/05/2021

END OF SECTION 019100

SECTION 02 41 13 – SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General, Supplementary, and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the selective removal and subsequent off-site disposal of, but is not limited to, removal of existing walks, curbs and pavements.
- B. Related work specified elsewhere includes relocation of utilities, pipes, conduits, ducts, and other mechanical and electrical work, and is specified in other Sections.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Submit Schedule: Indicating proposed sequence of operations for selective demolition work to Architect for review prior to start of work. Include coordination for shutoff, capping and continuation of utility services as required, together with details for dust and noise control protection.
 - 1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner operations.
 - 2. Coordination with Owner continuing occupation of existing building(s) and with Owner's partial occupancy of new building(s).
- C. Submit Photographs: Of existing conditions of structure surfaces, equipment, and adjacent improvements that might be misconstrued as damage related to removal operations. File with Owner's representative prior to start of work.
 - 1. Where finish involves normal color and texture variations, include Sample sets composed of two (2) or more units showing the full range of variations expected.
 - 2. include similar Samples of material for joints and accessories involving color selection.

- D. Protections: Provide temporary barricades and other forms of protection to protect Owner personnel, visitors and general public from injury due to selective demolition work, whether or not these are shown in Drawings.
1. Provide protective measures as required to provide free and safe passage of Owner's personnel, visitors and general public to existing building.
 2. Erect temporary covered passageways as required by authorities having jurisdiction
 3. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
 4. Protect from damage existing finish work that is to remain in place.
 5. Remove protections at completion of work.
- E. Damages: Promptly repair damages caused to adjacent surfaces or facilities by demolition work.
- F. F. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent facilities. Cooperate and coordinate with Owner officials.
1. Do not close, block, or otherwise obstruct streets, walks, or other facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways as required by Owner and City of Pearsall.
- G. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. Notify Local Fire Department before initiating each flame cutting operation.
- H. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by the Owner. Provide temporary services during interruptions to existing utilities, as acceptable to Owner.
 2. Maintain fire protection services during selective demolition operations.
- I. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.
1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Provide shoring, bracing, or support to prevent movement, settlement, or collapse of areas to be demolished and adjacent facilities to remain.
 - 1. Locate, identify, stub off, and disconnect utility services that are not indicated to remain.
 - a. Provide bypass connections as necessary to maintain continuity of service to existing Owner building. Provide minimum of 72 hours' advanced notice to Owner.

3.2 DEMOLITION

- A. General: Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.
 - 1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
 - 2. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction and by environmental regulations.
 - 3. Demolish foundation walls to a depth of not less than 12" below existing ground surface. Demolish and remove below-grade wood or metal construction. Break up below-grade concrete slabs.
 - 4. For exterior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related documents contain additional requirements for bidding, pricing, planning, coordinating, fabricating, installing, finishing, and completing the Work identified in this Section.
- C. For completion of the Work of this Section, all related documents must be examined by the Contractor, and requirements contained in other areas of the Contract Documents relating to the Work of this Section shall be incorporated into the Work of this Section.
- D. Additional requirements in the related documents include, but are not limited to, material and system quantity, location, placement, mounting, orientation, extents, proximity, and/or connection to other materials and systems to achieve the requirements of the Section and the requirements of adjacent and related work.
- E. Refer to Section 01 1113 - Work Covered by Contract Documents at the article entitled "GENERAL NOTES" for the paragraph entitled "Related Documents" regarding an expanded/explanatory version of the "RELATED DOCUMENTS" and for additional project requirements at other articles and paragraphs.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. This list of sections is applicable but not all inclusive. See other sections as required for the completion of the Work. The following documents include related requirements for the Work of this section and every other section affected by the Work.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 4. Section 017300 "Execution" for cutting and patching procedures.
 - 5. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- 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: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

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

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. 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 building manager's and other tenants' on-site operations are uninterrupted.
2. 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.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building 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: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

- E. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 - 2. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

- F. Storage or sale of removed items or materials on-site is not permitted.

- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
 - 1. Existing Secondary Canopy components.

- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

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

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 ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. 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.
- C. Engage a professional engineer to 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.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC 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. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
- B. 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.

- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the 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 4 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.
 - 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- 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.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 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.
- D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. 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 during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: 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.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to 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. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 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.

END OF SECTION 024119

SECTION 031000 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Construction Contract Clauses, Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

- A. Work includes but is not limited to:
 - 1. Provide formwork for cast-in-place and precast concrete.
 - 2. Install items supplied by other trades where the items must be placed as forms are erected. Locate these items from information supplied by the trades requiring them.
- B. Work of Other Sections:
 - 1. Applicable Sections of Division 3
 - 2. Concrete Curbs, Walks and Paving
- C. Applicability to Other Sections: Some requirements within this Section apply to the work of other Sections. The actual performance of the work stays within the Section where it occurs, but subject to the requirements of this Section, to the extent applicable.

1.3 QUALITY ASSURANCE

- A. Standards: Except as modified hereinafter, comply with applicable provisions and recommendations of ACI-347, "Guide to Formwork for Concrete", ACI-301, Chapter 4, "Specification for Structural Concrete for Buildings".
- B. Definitions:
 - 1. *Exposed Concrete*: Concrete exposed-to-view on interior and/or exterior including concrete which will receive finish materials, such as paint and wallcovering, applied directly to its surface. Not included is exposed concrete in mechanical and utility rooms.
 - 2. *Concealed Concrete*: Concrete covered by structure or with finish material other than that applied directly to its surface. Included is exposed concrete in mechanical and utility rooms.
 - 3. *Architectural Concrete*: Same as "exposed concrete" except special care is taken to achieve uniform shape, surface, texture and color. Architectural concrete is not to be covered with any other finish.
- C. Tolerances for Exposed Concrete:

1. General: Following is a list of the maximum permissible deviations from established lines, grades and dimensions for all exposed concrete.
 - a. Honeycombs, bubbles and similar defects are addressed in Section 033000, Concrete Finishes, and are to be distinguished from tolerances described herein.
 - b. Variations in the level of elevated concrete as floors and beams are to be measured before removal of supporting shores. The Contractor is responsible for adjusting the formwork to compensate for deflections of formwork including the deflections of the structure supporting the formwork.

2. Variation from Plumb:
 - a. In the lines and surfaces of columns, piers, walls and risers:

In 10 ft. (3 m)	-	¼ in. (6 mm)
In any story of 20 ft. (6m) max.	-	⅜ in (9mm)
In 40 ft (12m). or more	-	¾ in. (19 mm)
 - b. For exposed corner columns, control-joint grooves, and other conspicuous lines:

In any bay or story of 20 ft. (6m) max.	-	¼ in. (6 mm)
In any 40 ft. (12m) or more	-	½ in. (12 mm)

3. Variation from the Level or from the Grades Shown:
 - a. In floors, ceiling, beam soffits, joints and in treads:

In any 10 ft. (3.048m)	-	¼ in. (6 mm)
In any bay or 20 ft (6.1 m). max.	-	⅜ in. (9mm)
In 40 ft. (12.2 m) or more	-	¾ in. (19 mm)
 - b. For exposed lintels, joists, sills, parapets, horizontal grooves and other conspicuous lines:

In any bay or 20 ft (6.1 m). max.	-	¼ in. (6 mm)
In 40 ft. (12.2 m) or more	-	½ in. (12 mm)

4. Variation of the Linear Building Lines from Established Position in Plan and Related Position of Columns, Walls and Partitions:

In any bay or 20 ft. (6.1 m) max.	-	½ in. (12 mm)
In 40 ft. (12.2 m) or more	-	1 in. (25 mm)

5. Variation in the Sizes and Locations of Sleeves, Floor Openings and Wall Openings:

	-	¼ in. (6 mm)
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6. Variation in Cross-Sectional Dimensions of Columns, Beams, Joists and in the Thickness of Slabs and Walls:

Minus	-	¼ in (6 mm).
Plus	-	½ in. (12 mm)

7. Variation in Steps:
 - a. In a flight of stairs:

Rise	-	⅛ in.(3 mm)
Tread	-	¼ in. (6 mm)

b. In consecutive steps:

Rise	-	$\frac{1}{16}$ in. (1 mm)
Tread	-	$\frac{1}{8}$ in. (3 mm)

D. Tolerances for Concealed Concrete: Concealed concrete shall meet the following requirements:

1. Sufficiently accurate to accommodate the details of abutting work.
2. Measurably accurate so that the maximum deviation is not over $\frac{3}{8}$ in. in 8 ft.
3. Measurably accurate so that the total maximum deviation is not over 1 in. in 40 ft. or more.

E. Mock-Up or Sample Panels: Provide formwork for mock-up or sample panels as required by the Designer for cast-in-place and precast concrete work specified. Construct forms using facing materials required to provide required finishes and textures. Do not proceed with structure formwork until sample units and forms have been accepted.

1.4 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data and installation instructions for proprietary materials including form coatings, manufactured form systems, ties and accessories. Submit written certification by the form coating manufacturer that the form coating will not adversely affect the concrete surfaces as hereinafter specified.

B. Shop Drawings:

1. Submit shop drawings for fabrication and erection of formwork. Show the general construction of forms including jointing, special formed joints or reveals, temporary openings, location and pattern of form tie placement, and other items that affect the exposed concrete visually. Include details of inserts and anchorages. Indicate sequence of removal of forms.
2. The Contractor shall be solely responsible for the structural adequacy of the forms, ties, shoring and bracing. Any requirements given herein are minimum for appearance purposes only, not to be considered as structural design.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete:

1. Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other panel type materials acceptable to the Designer, providing continuous, straight, as-cast surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown.

Provide form material with sufficient thickness to withstand pressure of placed concrete without bow or deflection beyond allowable tolerances.

2. Use overlaid plywood complying with U.S. Product Standard PS-1, "B-B High Density Overlaid Concrete form," Class I.
 3. Use plywood complying with U.S. Product Standards PS-1, "B-B (Concrete Form) Plywood" Class I, Exterior Grade or better mill-oiled and edge-sealed, with each piece bearing the legible trademark of an approved inspection agency.
 4. Required Form Features:
 - a. True shape and edges.
 - b. Sharp, undamaged corners and edges.
 - c. Uniformly smooth, clean surfaces without checks or knots.
 - d. Free of damage, holes, bumps, warps and bends.
 - e. Hard, waterproof surface.
 - f. Single-unit forms without lapped joints for columns, beams and joists.
 5. Prohibited Forms:
 - a. Segmented units for joists.
 - b. Boards.
 - c. Plywood without high density overlay.
 - d. Earth forms.
 - e. Patched forms.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in the finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least 2 edges and 1 side for tight fit.
- C. Forms for Textured Finish Concrete: For textured finish concrete surfaces, provide size, arrangement, and configuration as shown or as required to meet Designer's control sample. Provide solid backing and form supports to ensure stability of textured form liners.
- D. Cylindrical Columns and Supports:
1. Form round-section members with paper or fiber tubes, constructed of laminated piles using water-resistant type adhesive with wax-impregnated exterior for weather and moisture protection.
 2. Provide units with sufficient wall thickness to resist loads imposed by uncured concrete without deformation.
 3. Provide units having "seamless" interior to minimize spiral gaps or seams.
 4. Provide manufacturer's standard plastic-lined-interior units.
 5. Form round-section members of not less than 12 ga.(2.6 mm) galvanized steel sheets. Butt section together, with bolted or keyed and welded joints. Finish interior joints or forms smooth so there is no visible seam on finished concrete surfaces.

E. Pan Forms:

1. Provide forms for concrete pan-type construction complete with covers and end enclosures to form a true, clean, smooth concrete surface. Design units for easy removal without damaging placed concrete. Block adjoining pan units if required to avoid lateral deflection of formwork during concrete placement and consolidation. Provide standard or tapered end forms, as shown on drawings.
2. Factory-fabricate pan form units to required sizes and shapes, of the following:
 - a. Steel: 16 ga.(1.5 mm) minimum, free of dents, irregularities, sag and rust.
 - b. Glass-Fiber Reinforced Plastic: Molded under pressure with matched dies, 0.11 in. (2.8 mm) minimum wall thickness.

F. Form Ties:

1. Provide factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent deflection, and to prevent spalling concrete surfaces upon removal.
2. Unless otherwise shown, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1-½ in. (38.1 mm) from the outer concrete surface. Unless otherwise indicated, provide form ties, which will leave a hole not larger than 1 in. (25.4) diameter in the concrete surface.
3. Form ties fabricated on the project site and wire ties are acceptable.
4. Provide 300 series stainless steel form ties for planned exposed tie hole locations, where shown, and for exposed or concealed architectural concrete. When used, break-back point shall be in 1 in. (25.4 mm) from outer concrete surface.

G. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

H. Inserts:

1. Provide metal inserts for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work.
2. Provide adjustable wedge inserts of malleable cast iron, complete with bolts, nuts and washers; minimum ¾ in. (19 mm) bolt size unless otherwise indicated.
3. Provide threaded inserts of malleable cast iron, furnished complete with full-depth bolts; minimum ¾ (19 mm) in. bolt size unless otherwise indicated.
4. Provide sheet metal reglets formed of the same type and gage as flashing metal to be built into the reglets, unless otherwise indicated. Where elastic sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 ga (0.48 mm) stainless steel sheet. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

I. Chamfer Strips: ¾ in. x ¾ in. (19 mm x 19 mm) virgin vinyl with ½ in. (12 mm) radius. Provide with ½ in. (12 mm) nailing leg at corner. Strip shall be continuous at all exposed concrete columns, beams, walls and floor edges.

2.2 DESIGN OF FORMWORK

- A. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose.
- B. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
- C. Design formwork to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials.
- D. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.
- E. Design formwork assemblies to take into account the placing rate, temperature, vibrating and retarding admixtures so all portions of the assembly withstand the concrete pressures without deformation beyond $1/360$ of spans.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates and adjoining construction, and conditions under which the Work is to be installed. Do not proceed with the Work until unsatisfactory conditions detrimental to the proper and timely completion of the work have been corrected.

3.2 FORM CONSTRUCTION

- A. General:
 - 1. Construct forms complying with ACI 347, to the sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and insets, and other features required. Use selected materials to obtain required finishes.
 - 2. Provide camber in formwork as required for anticipated deflections of formwork system and in-place construction due to weight and pressures during concrete placement and construction loads.
 - 3. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets recesses, and the like, to prevent swelling and assure ease of removal.

4. Provide temporary openings where interior area of formwork is inaccessible for cleanout for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible, consistent with project requirements.
5. Form intersecting planes to provide true, clean-out corners, with edge grain of plywood not exposed as form for concrete.
6. Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.
7. During concrete placement, check formwork and related supports to ensure that forms are not displaced and completed work will be within specified tolerances.
8. Engage a licensed surveyor to verify that the work is within specified allowable tolerances. The surveyor shall report in writing to the Designer, with copy to the Contractor, certifying the work as acceptable or indicating deviations from allowable tolerances.

B. Falsework:

1. Erect, support, brace and maintain falsework to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures.
2. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
3. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurately align, free from irregularities and within allowable tolerances.
4. Carefully inspect falsework and formwork during and after concrete placement operations to determine excessive deflection or signs of failure. Make necessary adjustments to produce work of required dimensions.

C. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Size and location of openings, recesses and chases are the responsibility of the trade requiring such items. Accurately place and securely support items to be built into forms.

D. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.3 FORMS FOR EXPOSED CONCRETE

A. General:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
2. Do not use metal cover plates for patching holes or defects in forms.

3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
4. Use extra studs, walers and bracing to prevent bowing of forms between studs.
5. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
6. Form molding shapes, recesses and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

B. Corner Treatment:

1. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise indicated.
2. Form chamfers with $\frac{3}{4}$ in. x $\frac{3}{4}$ in. (19 mm x 19 mm) strips, unless otherwise indicated, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer at changes in direction.
3. Non-exposed corners may be formed either square or chamfered.

C. Joint Locations:

1. Utilize largest available form units for minimum joint spacing of 8 ft. x 4 ft. (2 m x 1m).
2. Arrange joints in a symmetrical pattern so center of the surface involved is either a joint or the center of a form unit. Use form units of matching size where possible.
3. Arrange forms with continuous support at every joint to keep from offsetting during the placing operation.
4. Exposed construction joints not shown shall be made and located to least impair the strength of the structure.
5. Where a construction joint is to occur, thoroughly clean the surface of the concrete and removal all laitance. In addition, vertical joints shall be thoroughly wetted and slushed with a coat of neat cement grout immediately before placement of new concrete. A delay until the concrete is no longer plastic in columns or walls (minimum of 2 hours) must occur before concrete is placed in the beams or slabs to be supported.
6. At horizontal construction joints, provide 1- $\frac{1}{2}$ in. (38 mm) continuous blocking at top of first casting. Remove blocking and rebrace forming member tightly against first casting to form a leakproof joint for second placement.
7. There shall be no horizontal construction joints in concrete beams. Construction joints shall be made in the middle third of spans with vertical bulkheads. When a beam intersects a girder at this point, the joints in the girders shall be offset a distance equal to twice the width of the beam. The location of construction joints shall be approved by the Designer. Provide additional reinforcing at construction joints as directed by the Designer.
8. Construction joints in floors shall be located near the middle of the spans of slabs or beams.

3.4 FORMS FOR ARCHITECTURAL CONCRETE

- A. Comply with recommendations of ACI 303 "Guide to Cast-in-place Architectural Concrete Practice." Tolerances shall be the same as for "exposed concrete."

3.5 SHORES AND SUPPORTS

- A. Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.
- B. Extend shoring from ground to roof for structures 4 stories or less, unless otherwise permitted.
- C. Extend shoring at least 3 floors under floor or roof being placed for structures over 4 stories. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space out shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimum if required to ensure the proper distribution of loads throughout the structure.
- D. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support the work without excessive stress or deflection and without increasing cracking or propensity for cracking in the concrete.
- E. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until the concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.6 PREPARATION OF FORM SURFACES

- A. All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed in them.
- B. Unless otherwise specified or approved, surfaces of forms shall be treated as follows:
 - 1. Before placement of either reinforcing steel or concrete, the surfaces of the forms shall be covered with specified coating material. Steel forms shall be free of rust.
 - 2. High-density overlay plywood shall receive mill oil of 100 or higher viscosity, in accordance with APA recommendations.
 - 3. Excess form coating material shall not be allowed to stand in puddles in the forms nor shall such coating be allowed to come in contact with hardened concrete against which fresh concrete is to be placed.

3.7 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by concrete. Embedded plates must be secured in their proper location so that they will not be displaced during concrete placement. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.
- B. Edge Forms and Screeds Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

3.8 REMOVAL OF FORMS

- A. Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F. (10 degrees C.) for 24-hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided that curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs and other structural elements may not be removed in less than 14-days, and not until concrete has attained design minimum 28-day compressive strength. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of the concrete location or members, as specified under City's Testing Laboratory.
- C. Form facing material may be removed 4-days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.9 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to the Designer.

END OF SECTION 031000



05/05/2021

SECTION 032000 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Construction Contract Clauses, Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK:

- A. Work included: Fabrication and placement of reinforcement for cast-in-place concrete, including bars, welded wire fabric, ties and supports.
- B. Work of Other Sections:
 - 1. Applicable Sections of Division 3
 - 2. Concrete Curbs, Walks and Paving
- C. Applicability to Other Sections: Some requirements within this Section apply to the work of other Sections. The actual performance of the work stays within the section where it occurs, but subject to the requirements of this Section, to the extent applicable.

1.3 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's product data, specifications, and installation instructions for proprietary materials and reinforcement accessories.
- B. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315 "Details and Detailing of Concrete Reinforcement." Details shall include, but not be limited to sizes, grades of steel, bending and splicing details, splice locations, placement drawings for slab steel, minimum cover for steel and accessories, including positioning of reinforcement, and accessories, and how final position of reinforcement for slabs on grade are obtained.
- C. Mill Certification of Reinforcing: Provide a certified mill analysis and tensile and bend test report. If the reinforcing cannot be identified, provide one series of tests from each 10 tons or fraction thereof. The testing shall be performed by an independent testing laboratory satisfactory to the Designer. The costs shall be borne by the Contractor.

1.4 DELIVERY, HANDLING AND STORAGE

- A. Deliver reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement drawings.
- B. Store concrete reinforcement materials at the site, preventing damage, excessive rusting and accumulation of dirt and other deleterious substances.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars: Provide deformed reinforcing bars conforming to the requirements of ASTM A615 as follows:
 - 1. Grade 60: Use for bar sizes of No. 3 and larger, unless shown otherwise.
 - 2. Grade 40: May be used for No. 3 bars if so stated on the structural drawings.
 - 3. Weldable Grade 40: Use for bars which are shown on the structural drawings as being welded to steel members.
 - 4. Grade 75: Use where indicated on structural drawing.
- B. Steel Wire: ASTM A82, minimum 16 ga., annealed wire, galvanized.
- C. Welded Wire Fabric: ASTM A185.
 - 1. Furnish in flat sheets, not rolls.
- D. Supports for Reinforcement:
 - 1. Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.
 - a. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, and other unacceptable materials.
 - b. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - c. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dip galvanized or plastic protected or stainless steel protected legs, at Contractor's option.
 - d. For abrasive-blasted or bush-hammered concrete, provide special stainless bar supports (CRSI, Class E).

2.2 FABRICATION

- A. General: Form to dimensions and bends shown. Use cold forming methods that will not injure the material.

- B. Bending and Straightening: Reinforcement shall be carefully formed to the dimensions shown. Metal reinforcements shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown shall not be used. Heating of reinforcing will not be permitted.
- C. Design:
 - 1. Splices: When it is necessary to splice reinforcement other than as shown, the splice shall be determined by the Designer on the basis of allowable bond and stress in the reinforcement at the splice. Splicing shall not be made at points of maximum stress, nor shall adjacent bars be spliced at the same point. When several bars are spliced, laps shall be staggered.
 - 2. Horizontal wall reinforcement shall be continuous and shall have 90 degree bends and extensions at corners and intersections as shown.
 - a. Splices of reinforcing bars shall be made only as required or permitted by the Contract Documents, or as authorized by the Engineer.
 - b. Reinforcing bars partially embedded in concrete shall not be field bent, except indicated on the Contract of Documents or permitted by the Engineer/Architect. When heat is used to field bend epoxy-coated reinforcing bars, suitable ventilation shall be provided. When epoxy-coated reinforcing bars are field bent, coating damage shall be repaired in accordance with item 1.b.
 - c. Unless permitted by the Engineer/Architect, reinforcing bars shall not be cut in the field.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates and adjoining construction, and conditions under which the Work is to be installed. Do not proceed with the Work until unsatisfactory conditions detrimental to proper and timely completion of the work have been corrected.

3.2 INSTALLATION:

- A. General: Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars" and "Manual of Standard Practice," for details and methods of reinforcement placement and supports, and as herein specified.
- B. Cleaning: Reinforcing steel shall be cleaned and free of salts, mill scale and rust. Cleaning shall be by brushing or grit blasting and water just prior to placing. Following cleaning, the reinforcing shall be covered or protected from the elements until immediately prior to placing of concrete. When there is a delay in depositing concrete, reinforcement shall be reinspected and, when necessary, recleaned.
- C. Placing Reinforcement:

1. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
 2. Place reinforcement to obtain the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports together with wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directly away from exposed concrete surfaces.
 3. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one and one-half full mesh and lace splices with wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps. Comply with ACI 318 requirements for splicing mesh.
 4. Provide sufficient numbers of supports with strength to carry reinforcement. Do not place reinforcement bars more than 2 in. (50.8 mm) beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- D. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. Comply with requirements of ACI 318 for minimum lap of splicing bars.

END OF SECTION



05/05/2021

SECTION 032500 CONCRETE ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for providing concrete accessories shown and specified herein such as waterstops, dovetail anchor slots, cast-in-place reglets, inserts, joint filler, preformed joint seal, joint sealant and neoprene pads.
- B. Products Installed: Waterstops, dovetail anchor slots, cast-in-place reglets, inserts, joint filler, preformed joint seal, joint sealant and neoprene pads.
- C. Related Work Specified in Other Sections Includes:
 - 1. Section 03100 - Concrete Formwork
 - 2. Section 03200 - Concrete Reinforcement
 - 3. Section 03310 - Cast-in-Place Concrete

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. AASHTO - Standard Specifications for Highway Bridges
 - 2. ASTM A 240 - Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
 - 3. ASTM A 536 - Standard Specifications for Ductile-Iron Castings
 - 4. ASTM D 412 - Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
 - 5. ASTM D 3545 - Test Methods for Alcohol Content and Purity of Acetate esters by Gas Chromatography
 - 6. ASTM D 3575 - Test Methods for Flexible Cellular Materials Made From Olefin Polymers
 - 7. CRD-C513 - Specifications for Rubber Waterstops
 - 8. CRD-C572 - Specifications for Polyvinyl Chloride Waterstop
 - 9. Fed. Spec.

TT-S-00227 - Sealing Compound, Elastomeric Type, Multicomponent (for Calking, Sealing, and Glazing in Buildings and Other Structures)

10. Fed. Spec.

TT-S-00230 - Sealing Compound, Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures)

1.3 SUBMITTALS

A. General: Provide all Work related submittals, including the following, as specified in Division 1.

B. Product Data and Information:

1. Manufacturer's Data and Specifications: Submit printed manufacturer's data and specifications for each item used on this project.
2. Samples: Provide one sample of each item used.
3. Joint Sealant and Preformed Joint Seal: Indicate special procedures, surface preparation and perimeter conditions requiring special attention. All products in contact with potable water, shall be "NSF Standard 61" certified. Submit certified material records indicating approval for use with potable water.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Joint Filler
 - a. Sonoflex F Foam by Sonneborn Building Products
 - b. PVC Joint Filler No. 327 by A.C. Horn
2. Sealant Backup Material
 - a. Sealtight Backer Rod
 - b. Sonofoam Backer Rod

3. Preformed Joint Seal
 - a. Evazote 380, ESF by Epoxy Industries
4. Wedge Inserts
 - a. Type F-7 by Dayton Superior, Miamisburg, OH
5. Dovetail Anchor
 - a. A.A. Wire Products Co.
 - b. Dur-O-Wal Inc.
6. Flashing Reglets
 - a. Standard reglets by Beehive Anchoring System

2.2 MATERIALS

- A. Extruded Waterstops: Provide waterstops made of extruded polyvinyl chloride unless otherwise shown or specified.
1. Do not use any reclaimed plastic material in their manufacture.
 2. Provide plastic waterstops meeting the requirements of CRD-C572, except as modified herein. Provide a Shore A/10 durometer hardness between 73 and 79, the tensile strength not less than 1850 psi, and specific gravity not more than 1.38.
 3. Unless otherwise shown, use waterstops for construction joints which are flat, at least 6 inches wide, and not less than 3/8-inch thick at the thinnest section. Provide these waterstops with ribbed longitudinal strips.
 4. Unless otherwise shown, provide waterstops for expansion joints at least 9 inches wide and not less than 1/4-inch thick at the narrowest point and not less than 3/8-inch thick immediately adjacent to the center of the waterstop. Provide the waterstop with ribbed longitudinal strips with a 3/4-inch inside diameter hollow bulb center. Limit joint movement to 1/4-inch under a tensile force of not more than 500 pounds per lineal inch.
- B. Stainless Steel Waterstops: Provide stainless steel waterstops where shown or specified.
1. Fabricate stainless steel waterstops from ASTM A 240 Type 316, 20 gauge stainless steel, conforming to the dimensions and profiles shown.

2. Prefabricate and miter corners and intersections for all stainless steel waterstops. Make only butt joints in the field.
- C. Rubber Waterstops: Provide rubber water stops where shown or specified.
1. Provide rubber water stops of either the molded or extruded type, fabricated from a high grade tread type compound, either SBR or natural rubber, conforming to CRD-572-74.
 2. Provide water stops for construction joints at least 6 inches wide and 3/8inch thick and with solid end bulbs 3/4-inch in diameter.
 3. Provide water stops for expansion joints 9 inches wide and 3/8-inch thick and with solid end bulbs 1-inch in diameter and a hollow center bulb 1-1/2 inches in diameter with a 3/4-inch diameter center cavity.
- D. Expansion Joint Filler: Use joint filler for all expansion joints.
1. Provide a closed cell polyethylene or PVC joint filler of the thickness shown.
- E. Joint Sealant Requirements: Finish expansion joints with a joint sealant where shown or specified.
1. Joint sealant materials may be either a single component urethane compound meeting the requirements of Fed. Spec. TT-S-00230C, or a 2component urethane compound meeting the requirements of Fed. Spec. TTS-00227E, except as modified in this specification.
 2. Provide the urethane sealant of 100 percent polymer, non-extended, containing no solvent, lime, or coal tar. Color as selected by the ENGINEER, but not black. Conform sealant properties to the following:

	Property	Value	Test Method
a.	Maximum final cure	3 days	--
b.	Minimum tensile strength	140 to 200 psi	ASTM D 412
c.	Minimum elongation	400%	ASTM D 412
d.	Modulus at 100% elongation	40-60 psi	ASTM D 412
e.	Shore A hardness	25-40	ASTM D 2240

Property Value	Test			Method
	f.	Solid content	98-100%	--
	g.	Peel strength	20-40 lb/in.	Fed. Spec. TT-S00230C Fed. Spec. TT-S-00227E
	h.	Minimum recovery	80-90%	Fed. Spec. TT-S00230C Fed. Spec. TT-S-00227E
	i.	Initial tack-free cure	24-48 hrs.	Fed. Spec. TT-S00230C Fed. Spec. TT-S-00227E

3. Provide primer as recommended by the manufacturer of the sealant, subject to approval.
 4. Provide fillers and backup materials in contact with sealant which are nonimpregnated and free from asphalt, creosote, oil or extractable plasticizers. Use a backup material of a closed cell polyethylene foam rod with a diameter 1/4-inch larger than the joint width.
- F. Preformed Joint Seal: Provide a preformed joint seal where shown or specified.
1. Provide joint material which is resilient, non-extrudable, impermeable, closed-cell, cross-linked, ethylene vinyl acetate, low density, polyethylene copolymer, nitrogen blown material which is ultraviolet light, weather and wear resistant, and which is concrete beige in color.

2. Conform material properties with the following:

Property	Value	Test Method
a. Density, pcf	2.8 to 3.4	ASTM D 3575 Suffix: W, Method A
b. Water Absorption total immersion 3	0.02% by volume	ASTM D 3575 Suffix: L

- | | months | Property | Value | Test Method |
|----|--------|----------------------------|-----------------------------|-------------|
| c. | | Tensile Strength | 125 psi ASTM D 3575 Suffix: | T |
| d. | | Elongation before breaking | 255% ASTM D 3575 Suffix: T | |
| e. | | Working Temperature | -94 to 160 F | -- |
- G. Neoprene Pads: Use neoprene pads as shown or required where slabs or beams must be prevented from bonding to footings, walls, columns or other rigid parts of the structure.
1. Use neoprene pads of a structural grade meeting the requirements of Section 25, Division 2 of the AASHTO Standard Specifications for Highway Bridges.
 2. Do not use neoprene pads thinner than 1/4-inch.
- H. Wedge Inserts: Make wedge inserts for 5/8-inch and 3/4-inch bolts of ductile iron conforming to ASTM A 536.
- I. Dovetail Anchors: Provide dovetail anchors of one of the following types:
1. Dovetail anchors having a 3/16-inch by 1-inch by 1/2-inch stainless steel dovetail section with 3/16-inch diameter stainless steel wire.
 2. Dovetail anchor slots of 24 gauge galvanized steel 1-inch by 1-inch by 5/8inch throat. Fill anchor slots.
- J. Flashing Reglets: Provide flashing reglets of 24 gauge galvanized steel foam filled reglets.

PART 3 EXECUTION

3.1 INSTALLING OF WATERSTOPS

- A. Assembly of Extruded Waterstops: Prefabricate corners and intersections for all waterstops. Make only butt joints in the field. Miter and assemble corners and intersections with approved equipment, as described for field joints.
1. Make field joints by cutting the ends of the sections to be spliced so they will form a smooth even butt joint. Heat the cut ends with the splicing tool until the plastic melts. Press the two

ends together until the plastic cools. Do splicing in a way that limits damage to the continuity of the ribbed strips.

2. Carry waterstops in the walls into lower slabs and join them to the waterstops in the slabs. Make all waterstops continuous. Set waterstops accurately to the position and line shown. Hold edges securely fixed in position at intervals of not more than 24 inches so that they will not move during the placing of the concrete. Do not drive nails through the waterstops.
- B. Prefabricated Stainless Steel Waterstops: Prefabricate corners and intersections for all stainless steel waterstops. Make only butt joints in the field. Miter and weld corners and intersections.
1. Provide field joints having a nominal 1-inch lap joint, with the exposed edge welded or brazed on each side.
 2. Make field joints with PVC waterstops as shown.
 3. At expansion joints, seal the base of the expansion section of the waterstop with at least one layer of 2-inch wide duct tape.
 4. Carry waterstops in the walls into lower slabs and join them to the waterstops in the slabs. Make all waterstops continuous. Set waterstops accurately to the position and line shown. Hold edges securely fixed in position at intervals of not more than 24 inches so that they will not move during the placing of the concrete. Do not drive nails through the waterstops.
- C. Splices: Use splices made in the manufacturer's plant where possible for rubber waterstops.
1. Use a preformed rubber union or fitting and splicing cement as recommended by the manufacturer when splices are made.
 2. Carry waterstops in the walls into lower slabs and join them to the waterstops in the slabs. Make all waterstops continuous. Set waterstops accurately to the position and line shown. Hold edges securely fixed in position at intervals of not more than 24 inches so that they will not move during the placing of the concrete. Do not drive nails through the waterstops.
- D. Joint Filler Placement: Place joint filler for expansion joints against the completed portion of the work before the concrete for the next section is placed.
1. Fasten the filler to the hardened concrete with a compatible adhesive in accordance with manufacturer's instructions. Extend the filler through the thickness of the wall or slab and make it flush with the finished surface, except where a preformed joint seal or joint sealant is shown.

2. In joints having a waterstop, fit the filler accurately on each side of the waterstop to prevent the intrusion of concrete.
- E. Preparation of 2-Component Sealants: Mix 2-component joint sealant using a slotted paddle and slow speed mixer for 5 to 8 minutes, continually working paddle from top to bottom until the sealant color is uniform. Scrape down the side of the container and paddle blade several times during the mixing operation to ensure uniform mixing.
1. Properly prepare joint surfaces by removing all foreign matter and concrete laitance so that concrete surfaces are structurally sound, clean, dry, and free of all oil, grease, wax, waterproofing compounds or form release materials prior to the application of primer and sealant.
 2. Prime all concrete joint surfaces and all surfaces exposed to water prior to sealing, with no exceptions. Prime all other surfaces as recommended by the manufacturer of the sealant. Provide the prime as recommended by the manufacturer of the sealant, subject to approval. Apply the primer by either brushing or spraying on the joint surfaces. Apply and install the sealant within 2 to 24 hours after the application of primer.
 3. For horizontal joints, install the sealant by pouring directly from a suitable shaped can or by flowing from a bulk-loading gun.
 4. Fill vertical joints from a gun, starting from the bottom, to avoid bridging and the formation of air voids.
 5. Fill overhead joints from a gun, by laying a bead along each side of the joint and then filling the middle. Immediately after installation, tool in the sealant in order to establish firm contact with joint surfaces and to provide a smooth sealant surface. Tool in accordance with the manufacturer's instructions.
 6. Control joint depth with the use of joint fillers and backup materials. Make joint widths and sealant depths as shown. Do not exceed 1/2-inch for sealant depth.
- F. Preformed Joint Seal Surface Preparation: Properly prepare joint surfaces by removing all foreign matter and concrete laitance so that concrete surfaces are structurally sound, clean, dry, and free of all oil, grease, wax, water-proofing compounds or form release materials.
1. Blast clean or saw cut all existing concrete surfaces to expose a clean bare concrete surface. Allow new concrete to be well cured, and attain a minimum of 80 percent of the specified strength before installing sealant.

2. Apply bonding adhesive, as recommended by the manufacturer to the concrete surfaces in strict compliance with the manufacturer's recommendations. Install the joint material under a compression of 25 percent and in one continuous operation, in accordance with manufacturer's recommendations. Do all splices and directional changes using heat welding method as recommended by the manufacturer.
- G. Unbonded Joints: Use unbonded horizontal joints as shown or required where slabs of beams must be prevented from bonding to footings, walls, columns or other rigid parts of the structure.
1. Prevent bonding by use of structural grade neoprene pads placed over the bearing surface of the footing, wall or other supporting part of the structure so as to isolate it from the new concrete being placed.
- H. Encasing Inserts: Encase wedge inserts, flashing reglets and dovetail anchor slots in the concrete as shown. Take special care to place and maintain them to the proper lines and grades and to compact concrete thoroughly around them to prevent the passage of water. Set these items before placing concrete and thoroughly brace them to prevent movement during the progress of the work. Provide dovetail anchor slots spaced not more than 16 inches apart for all concrete walls faced with masonry.

END OF SECTION

SECTION 033000 – CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Construction Contract Clauses, Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: This Section covers concrete materials, accessories, mixing, placing, finishing, curing and protection, and manufacture of concrete roof pavers.
- B. Work of Other Sections:
 - 1. Applicable Sections of Divisions 2 and 3
 - 2. Concrete Curbs, Walks, Paving, Slurry Walls, Caissons and Drilled Piers.
 - 3. Independent Testing Laboratory.
- C. Applicability to Other Sections: Some requirements given within this Section apply to the Work of other sections. The actual performance of the Work stays within the section it occurs, but subject to the requirements of this Section to the extent applicable.

1.3 QUALITY ASSURANCE:

- A. Codes and Standards:
 - 1. Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified.
 - a. ACI 301 "Specifications for Structural Concrete for Buildings."
 - b. ACI 311 "Recommended Practice for Concrete Inspection."
 - c. ACI 318 "Building Code Requirements for Reinforced Concrete."
 - d. ACI 347 "Guide to Formwork for Concrete."
 - e. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete."
 - f. ACI 302 "Guide for Concrete Floor and Slab Construction."
 - g. ACI 303 "Guide to Cast-in-Place Architectural Concrete."
 - h. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
 - i. Comply with Building Code requirements that are more stringent than the above.
 - 2. Workmanship: The Contractor is responsible for correction of concrete work, which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Designer.

1.4 SUBMITTALS:

A. Concrete Mix Designs:

1. All mix designs shall be proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318-89. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture test data. Submit mix designs on each class of concrete for review on the Mix Design Submittal Form attached at the end of this Section. The cost of all Trial Mixtures, Mix Designs and associated Tests shall be borne by the Contractor.
2. These mix designs shall be prepared in accordance with 211.1 for normal weight concrete and report to the Architect the following data:
 - a. Complete identification of aggregate source of supply.
 - b. Tests of aggregates for compliance with specified requirements.
 - c. Scale weight of each aggregate.
 - d. Absorbed water in each aggregate.
 - e. Brand, type and composition of cement.
 - f. Brand, type and amount of each admixture.
 - g. Water content.
 - h. Proportions of each material per cu. yd.
 - i. Gross weight and yield per cu. yd. of proposed mix.
 - j. Measured initial and final slump.
 - k. Measured air content.
 - l. Compressive strength developed at 7 days and 28 days, from trial mixture test data or from standard deviation analysis of previous test results.
3. Submit written reports to the Designer for each proposed mix of each type of concrete on the Mix Design Submittal Form at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Designer.

B. Laboratory Trial Batches:

1. Prepare test specimens in accordance with ASTM C192 and conduct strength test in accordance with ASTM C39, as specified in ACI 301.
2. Establish a curve showing relationship between water-cement ratio (or cement content) and compressive strength, with at least 3 points representing batches that produce strengths above and below that required. Use not less than 3 specimens tested at 28-days or an earlier age, when acceptable to the Designer, to establish each point on the curve. If trial batches are used, the mix design shall be prepared by an independent testing laboratory and shall achieve an average compressive strength 1200 psi higher than the specified strength. This over-design shall be increased to 1400 psi when concrete strengths over 5000 are used.

C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the Government and as accepted by the Architect. Laboratory tests data for revised mix designs and strength results must be submitted to and accepted by the Designer before using in the Work.

D. Admixtures:

1. Use air-entraining admixture in exterior concrete, unless otherwise indicated. Add air-entraining admixture to concrete at the manufacturer's prescribed rate to result in having air content (at the point of placement) within the following limits.
 - a. Concrete structures and slabs exposed to freezing and thawing to subject to hydraulic pressure:
 - 1) 4% for maximum 2 in. aggregate.
 - 2) 6% for maximum $\frac{3}{4}$ in. aggregate.
 - 3) 7% for maximum $\frac{1}{2}$ in. aggregate.
 2. All concrete must contain the specified water-reducing admixture or the specified high-range water-reducing admixture (superplasticizer).
 3. All concrete slabs placed at air temperatures below 50 degrees F shall contain the specified non-corrosive, non-chloride accelerator. All concrete required to be air entrained shall contain an approved air entraining admixture.
 4. All pumped concrete or concrete with a water/cement ratio below 0.50 shall contain the specified high-range water-reducing admixture (superplasticizer).
- E. Slump:
1. All concrete containing the high-range water-reducing admixture (superplasticizer) shall have a maximum slump of 9" unless otherwise approved by the Designer.
 2. The concrete shall arrive at the job site at a slump of 2" to 3,"(3"to 4") for concrete receiving a "shake-on" hardener to lightweight concrete), to be verified then the high-range water-reducing admixture added to increase the slump to the approval level.
 3. All other concrete shall have a maximum slump of 4".
- F. Water/Cement Ratio: All concrete subject to freezing and thawing shall have a maximum water/cement ratio of 0.50 (4000 psi at 28 days or more). All concrete subjected to deicers and/or required to be watertight shall have a maximum water/cement ratio of 0.45)4500 psi at 28 days or more) All reinforced concrete subjected to brackish water, salt spray to deicers shall have a maximum water/cement ratio of 0.40 (5000 psi at 28 days or more).
- G. Manufacturer's Data:
1. Submit manufacturer's product data, specifications with application and installation instructions for proprietary materials and items, including admixtures, bonding agents, waterstops, joint systems, curing compounds, and dry shake finish materials.
 2. Submit and secure approval of the Designer for the following data, information and procedures:
 - a. Cement: Source of supply, physical and chemical characteristics, transportation and intermediate terminating and storage procedures from mill to project and site storage procedures.
 - b. Aggregate: Physical and chemical properties, procurement, processing and storage facilities.
 - c. Mixing Water: Source and chemical analysis.
 - d. Equipment: Description and handling capacities for concrete placement to include buckets, chutes, pump and tremies. Concrete consolidation equipment technical data.
 - e. Concrete:
 - 1) Batching and mixing equipment and procedures.

- 2) Transport equipment and description of techniques.
 - 3) Curing procedures
 - 4) Mix designs for each type of concrete including trial batch results, ingredients, physical properties.
 - 5) Hot and Cold Weather Concreting precautions and procedures.
- H. Samples: Submit samples of materials as specified and as otherwise may be requested by the Architect, including names, sources and descriptions as required.
- I. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test results.
- J. Placement Schedule: Prepare a placement schedule and submit to Architect for review prior to start of placement.
- K. Delivery Tickets: Furnish copies of delivery tickets for each load of concrete delivered to the site. Provide items of information as specified hereinafter.
- 1.5 PRODUCT HANDLING: Comply with ACI 301, chapter 2, paragraph 2.5 and ACI 304.
- A. The Designer will be present at the conference. The Contractor shall notify the Designer at least 7 days prior to the scheduled date of the conference.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS:

- A. Portland Cement:
1. ASTM C150, as follows:
 - a. Provide Type I cement, except as otherwise indicated. Type III cement may be used in lieu of Type I at Contractor's option, when approved by the Architect.
 - b. Use only one brand of cement for each required type throughout the project, unless otherwise accepted by the Architect.
- B. Normal Weight Aggregates:
1. General:
 - a. Provide aggregates complying with ASTM C33, from selected sources with acceptable limits of contaminants to meet requirements herein described.
 - b. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite or ochre which can cause stains on exposed concrete surfaces.
 - c. The total chloride content in the coarse and fine aggregates shall not exceed 0.05 lbs./cu.yd. for concrete subjected to deicers, brackish water, salt spray in service. Air content maximum in other concrete shall be as approved by the Engineer.
 2. Fine Aggregate:
 - a. Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.

- b. Fine aggregates shall contain no greater than 0.1% by weight of chlorides and no greater than 0.4% by weight of sulfates.
- 3. Coarse Aggregate:
 - a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - 1) Crushed stone, processed from natural rock or stone.
 - 2) Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted.
 - 3) Blast-furnace slag, crushed and processed from air cooled, iron blast-furnace slag weighing not less than 70 lbs./cu. ft. (1 121.3 kg/cu. m) in the dry, compacted state when determined in compliance with ASTM C29.
 - b. Coarse aggregate shall not be larger than one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, nor three-fourths of the minimum clear spacing between individual reinforcing bars or bundles of bars.
 - c. Coarse aggregate shall be $\frac{3}{4}$ in.(19 mm) maximum size and $\frac{3}{8}$ in.(9.5 mm) minimum size.
 - d. Coarse aggregate shall contain no greater than 0.025% by weight of chlorides and no greater than _____ by weight of sulfate unless otherwise approved by the Engineer.
- C. Supply of Aggregates: Provide aggregates from one source of supply to ensure uniformity in color, size and shape.
- D. Water: Clean, fresh, potable.

2.2 CONCRETE ADMIXTURES:

- A. General: Provide admixtures produced by established reputable manufacturer's and use in compliance with the manufacturer's printed directions. Do not use admixtures that have not been incorporated and tested in accepted mixes, unless otherwise authorized in writing by the Architect.
- B. Air-Entraining Admixtures: ASTM C260.
- C. Water-Reducing Admixture: The admixture shall conform to ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water. Provide one of the following:
 - 1. Eucon WR-75 or WR-89; The Euclid Chemical Co.
 - 2. Pozzolith 200N; Master Builders
 - 3. Plastocrete 160; Sika Chemical Corp.