

Riverside County – Volunteers in Medicine Clinic
82-915 Avenue 48
Indio, CA.
Project #0901.00

SECTION 01700
PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment, and services for project closeout as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See General Conditions and Supplementary Conditions for additional general requirements.
5. See technical sections for specific submittal items.

1.02 SUBMITTALS

A. Project data:

1. For substantial completion:
 - a. List of all items to be completed or corrected.
 - b. Written notice of substantial completion.
 - c. Certificates of governing authorities.
 - d. Initialed punch list.
2. For final completion:
 - a. Written certification that work is complete.
 - b. Evidence of payments and release or waiver of liens.
 - (1) In accordance with Section 00700 – General Conditions.

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- c. Final application for payment in accordance with Section 00700 – General Conditions.
- d. List of all sales and services taxes.
- e. Letter of pad elevation certification.
- f. Record drawings completed.
- g. Warranties and guarantees.
- h. All equipment operation manuals.

1.03 FOR SUBSTANTIAL COMPLETION

- A. Obtain evidence of compliance with requirements of governing authorities.
 - 1. Certificates of inspection of:
 - a. Mechanical
 - b. Electrical
 - c. Plumbing
 - 2. Certificate of occupancy.
- B. Submit written notice, including list of all items to be completed or corrected, which states that Project, or designated portion thereof, is substantially complete.
- C. Architect will, within reasonable period after notification, review the work and list of items to be completed or corrected, and revise or add to list if necessary.
- D. If Architect does not agree that work is substantially complete:
 - 1. He shall immediately notify Contractor in writing, stating reasons.
 - 2. Contractor must substantially complete work and submit second written notice, including list of items to be completed or corrected, that Project, or designated portion thereof, is substantially complete.
 - 3. Architect will again review the work and list of items to be completed or corrected.

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- E. If Architect agrees that work is substantially complete:
 - 1. Architect will prepare punch list for project, or designated portion thereof, and will provide one copy each to Contractor and Owner.
 - 2. Architect will return revised list of items to be completed or corrected, and punch list to Contractor.
 - 3. Architect will prepare Certificate of Substantial Completion, AIA G-704, accompanied by revised list of items to be completed or corrected and punch list.
 - 4. Owner may occupy Project, or designated portion thereof, at this time, under provisions stated in Certificate of Substantial Completion.
- F. If Owner is going to occupy project, or designated portion thereof, Contractor must perform final cleaning of designated portion, prior to occupancy.
- G. Contractor shall complete work listed for completion or correction and all punch list items, within designated time, and return both lists with each item initialed and dated to indicate completion.

1.04 FOR FINAL COMPLETION

- A. Submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Project has been inspected for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. Equipment and systems have been tested and are operational.
 - 5. Project is complete in every respect.
- B. Architect will make final “walk through” within thirty (30) days after receipt of certification.
- C. Contractor shall remedy any remaining deficiencies, and submit final closeout submittals.
- D. Should final completion be materially delayed through no fault of Contractor, Contractor may submit application for payment for portion of work on punch list which has been completed, in accord with provisions of General Conditions.

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- E. Upon completion of project, before final payment, furnish Owner, in triplicate, certified list of all sales and services taxes paid by Contractor (and subcontractors) in execution of this Contract.
- F. Provide all written warranties and guarantees per Section 01750, prior to Final Payment.
- G. Provide Record Drawings per Section 01720, prior to Final Payment.
- H. Provide all operational manuals for all equipment and/or systems, per Section 01730. Such information is to be prepared and presented in an organized neat binder, prior to Final Payment.

END OF SECTION

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SECTION 01710

CLEANUP

PART 1 - GENERAL

1.01 DESCRIPTION:

A. General:

1. Furnish all labor, materials, tools, equipment, and services for cleaning up required in conjunction with work performed, as indicated or required, in conjunction with work performed, as indicated or required, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 FIRE PROTECTION

- A. Store volatile waste in covered metal containers.
- B. Remove from premises daily.

1.03 POLLUTION CONTROL

- A. Conduct clean-up and disposal operations to comply with local ordinances and anti-pollution laws.
- B. Do not bury or burn rubbish and waste on site.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS

- A. Use materials recommended by manufacturers of surfaces to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.01 GENERAL

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- A. Clean all items installed under this Contract.
 - 1. Leave free of stains, damage, or other defects prior to final acceptance.
 - 2. Include washing, sweeping, polishing of all finished wall surfaces, floors, windows, hardware, mirrors, lighting fixtures and items of equipment.
 - 3. See technical sections for additional cleaning requirements.

3.02 DURING CONSTRUCTION

- A. Clean up all waste materials, rubbish, and debris resulting from the work on a daily basis.
- B. Ensure that building and grounds are maintained free from accumulations of debris.
- C. Sprinkle dusty debris with water.
- D. Daily clean-up site and access and dispose of debris off site.
- E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from interior and exterior surfaces of fixtures, hardware, and equipment.
- F. Repair, patch, and touch-up marred surfaces to match adjacent finishes damaged by his own operations.
- G. Comply with additional requirements defined in specifications.
- H. Vacuum interior areas when ready for painting.
- I. Schedule cleaning operations so that contaminants resulting from cleaning do not fall on wet painted surfaces.
- J. Clean all glass and aluminum surfaces.
- K. Leave the work "vacuum clean".

3.03 FINAL CLEANING

- A. Use experienced workmen or professional cleaners for final cleaning.
- B. At completion of construction, just prior to acceptance or occupancy, perform final cleaning.
- C. Remove dirt, stains, labels, and foreign materials.
- D. Repair and touch-up marred areas.

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- E. Broom clean paved surfaces; rake clean other surfaces of grounds; vacuum, polish and mop floors.
- F. Replace air conditioning filters if units were operated during construction.
- G. Clean ducts, blowers, and coils if air conditioning units were operated without filters during construction.

END OF SECTION

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SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services to provide project record documents as specified, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. See Division 1 for additional General Requirements.

B. Project Record Documents: Complete set of all documents required for construction with exception of samples and mock-ups.

1. Do not use for construction of project.
2. Provide contract drawings in form of "pink bond" prints.
3. Project Record Documents include but are not limited to:
 - a. Contract drawings.
 - b. Project specifications.
 - c. Addenda.
 - d. Shop drawings.
 - e. Project data.
 - f. Product data.
 - g. Change orders.
 - h. Modifications.
 - i. Field test records.

1.02 SUBMITTALS (SEE SECTION 01340)

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A. Project Data:

1. Provide Project Record Documents, at completion of project, to Architect with letter of transmittal.
2. Provide transmittal letter containing:
 - a. Date.
 - b. Project title.
 - c. Contractor's name and address.
 - d. Title and number of each Project Record Document.
 - e. Certification that Project Record Documents submitted are complete and accurate.
3. Copy of transmittal letter to Owner.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 POSTING PRIOR TO CONSTRUCTION

- A. After Contract is executed, but prior to start of construction, obtain Contract Drawings and Project Specifications which will be used for Field Documents and Periodic Update Documents.
- B. Obtain copies of all addenda and post above documents.

3.02 MAINTENANCE OF FIELD DOCUMENTS

- A. Maintain minimum of one copy of each document required for Project Record Documents at project site. Also, maintain one set of all samples and mock-ups.
- B. Label each document "FIELD".
- C. These documents will be used for construction of projects.
- D. Make documents available at all times for review by Architect, Owner, and authorities having jurisdiction.

3.03 MAINTENANCE OF PERIODIC UPDATE DOCUMENTS

- A. Maintain a separate set of all Field Documents on "pink bond" paper at project site.

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- B. Label each document "PERIODIC UPDATE".
- C. Do not use these documents for construction purposes.
- D. Make documents available at all time for review by Architect, Owner and authorities having jurisdiction.
- E. Maintain in clean, dry, legible condition.
- F. Maintain contract drawings in stackable, enclosed file drawers designed to hold drawings horizontally.
- G. Maintain all other Periodic Update Documents in stackable, enclosed file boxes designed to hold specific type of document.
 - 1. Provide index of contents of each box on outside of box.

3.04 POSTING AND UPDATING OF PERIODIC UPDATE DOCUMENTS

- A. Post and update on weekly basis.
- B. Contract drawings: Mark legibly to record actual construction including but not limited to:
 - 1. Depths of various elements of foundations in relation to first floor level.
 - 2. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 - 3. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - 4. Field changes of dimension and detail.
 - 5. Changes made by change order or field order.
- C. Project Specifications: Type on each section to record all changes including but not limited to:
 - 1. Addenda
 - 2. Change order or field order
 - 3. Modifications to contract
 - 4. Bind added sections into Project Specification

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- 5. Indicate manufacturer
- D. Do not conceal work for which information must be recorded until all required information is recorded on Periodic Update Documents.
- E. Any work concealed prior to recording of required information will be exposed. Once all required information is recorded on Periodic Update Documents, work will be restored at contractor's expense.

3.05 PRODUCTION OF PROJECT RECORD DOCUMENTS

- A. At substantial completion, provide complete set of "pink bond" for each contract drawing.
- B. Label each document "PROJECT RECORD".
- C. All other Periodic Update Documents may be used for Project Record Documents provided they are in satisfactory condition.
- D. Replace any Periodic Update Document found to be in unsatisfactory condition. Transfer all recorded changes from original to replacement copy.
- D. Final payment or a minimum of 10% will be withheld from the Contractor until all record drawings have been completed and delivered to the Architect.
- E. On completion of the work, prepare survey of site to show actual elevations, grades, site features and building location.

END OF SECTION

SECTION 01730

OPERATIONS AND MAINTENANCE MANUALS AND PARTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section covers the general requirements for Operations and Maintenance Manuals, space parts and extra materials.

1.02 SUBMITTALS

- A. Submit (2) two copies of completed volumes 15 days prior to final inspection. These copies will be reviewed and returned, with Architect comments. Revise content of all document sets as required prior to final submission.
- B. Submit (2) copies of revised final volumes in final form within 10 days after final inspection.
- C. For equipment, or component parts or equipment put into service during construction and operated by Owner, submit documents within 10 days after acceptance.

1.03 QUALITY ASSURANCE:

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.04 FORMAT

- A. Prepare data in the form of instructional manuals.
- B. Binders: Commercial quality, 8 ½" x 11", three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- D. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- E. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- F. Drawings: Provide with reinforced punched binder tags. Bind in with text; fold larger drawings to size of text pages.
- G. Arrange content by systems under section numbers and sequence of Table of Contents.

1.05 CONTENTS, EACH VOLUME

- A. Table of Contents: Provide title of project; names, addresses, and telephone numbers of Architect, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use project record documents as maintenance drawings.
- E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

1.06 MANUAL FOR MATERIALS AND FINISHES

- A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for reordering custom manufactured Products.
- B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture Protection and weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Each item Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed or by label machine.
- C. Include color coded wiring diagrams as installed.

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- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- N. Include air balance report.

1.08 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

PART 2 – PRODUCTS (NOT USED)

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PART 3 – EXECUTION

3.01 MAINTENANCE MATERIALS AND SPARE PARTS

- A. Furnish and deliver special tools, instruments, accessories, spare parts, and maintenance materials required by the contract documents, and furnish and deliver the special tools, instruments, accessories, and the special lifting and handling devices shown in the instruction manuals approved above.

- B. Unless otherwise specified or directed, deliver the items to the Owner, with the Contractor's written transmittal accompanying each shipment, in the manufacturer's original containers labeled to describe the contents and the equipment for which it is furnished. Deliver a copy of each transmittal to the Architect for record purposes.

END OF SECTION

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SECTION 01735

OWNER INSTRUCTION FOR EQUIPMENT AND SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all equipment demonstration and owner personnel instruction as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Provide instruction for all equipment and systems for which operating and maintenance data is required. See individual sections.

1.02 QUALITY ASSURANCE

A. Instructors: Member(s) of installers' staffs and authorized representative(s) of equipment, subject to Owner's approval.

1. Submit report (form attached) with preliminary information indicated, to Owner at least two weeks prior to first instruction period.
2. Submit separate completed report for each system: one copy each to Owner and Architect.

1.04 JOB CONDITIONS

A. Complete all instruction prior to substantial completion.

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 PREPARATION

- A. Do not begin instructions until the component, assembly or system has been tested as specified and is in satisfactory operating condition.
- B. Assemble instructional aids.
 - 1. Have operating and maintenance data available for use during instruction (see Section 01730).

3.02 INSTRUCTION

- A. Instruct Owner's personnel in operation and maintenance of equipment and systems.
 - 1. Provide all necessary instruction to satisfaction of Owner.
- B. Explain use of operating and maintenance manuals.
- C. Tour building areas involved and identify:
 - 1. Maintenance points and access.
 - 2. Control locations and equipment.
- D. Explain operating sequences.
 - 1. Identify location and show operation of switches, valves, etc., used to start, stop and adjust systems.
 - 2. Explain use of flow diagrams, operating sequence diagrams, etc.
 - 3. Demonstrate operation through complete cycle(s) and full range of operation in all modes, including testing adjusting relevant to operation.
- E. Explain use of control equipment, including temperature settings, switch modes, available adjustments, reading of gauges, and functions that must be serviced only by authorized factory representative.
- F. Explain trouble-shooting procedures.
 - 1. Demonstrate commonly occurring problems.
 - 2. Note procedures which must be performed by factory personnel.
- G. Explain maintenance procedures and requirements.
 - 1. Point out items requiring periodic maintenance.

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2. Demonstrate typical preventive maintenance procedures and recommend typical maintenance intervals.
 3. Demonstrate other commonly occurring maintenance procedures not part of preventive maintenance program.
 4. Identify maintenance materials to be used.
- H. Have all tools required for instruction available.

END OF SECTION

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EQUIPMENT AND SYSTEMS OWNER INSTRUCTION REPORT

System or Equipment: (Complete one form for each separate system)

NOTE: The Contractor's Representative shall maintain and complete this report during the course of instruction.

I. Preliminary Information

A. To be completed by Contractor:

1. Proposed dates for instruction period:
 _____ to _____
2. Contract Representative conducting instruction:

3. Number of hours of instruction required:

B. To be completed for Owner: (Information obtained from Owner)

1. Owner's personnel to be instructed (Designate supervisor, if required.)

- | | | |
|----------|----------|----------|
| a. _____ | e. _____ | i. _____ |
| b. _____ | f. _____ | j. _____ |
| c. _____ | g. _____ | k. _____ |
| d. _____ | h. _____ | l. _____ |

II. Instruction Log

Date	No. Hours	Material Covered	Instr. Initial	Owner's Receiving	Personnel Instruction	Initial Comments

Total: _____

Date Instruction Completed: _____
 Instructor's Signature: _____

Owner's Representative's Signature: _____

SECTION 01750

WARRANTIES AND GUARANTEES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide written guarantees for products and installations indicated.
- B. Provide guarantees for period(s) indicated.
 - 1. All portions of the work shall be guaranteed against defects in workmanship and materials for a minimum period of one (1) year from date of acceptance of the structure, unless a longer guarantee is specifically called for herein.
- C. For guarantees required and guarantee periods, see General Provisions.
- D. Provide manufacturer's guarantees for products.
 - 1. Where manufacturer's standard guarantees expire before expiration date required by Contract Documents, obtain and pay for guarantee extensions, at no additional cost to Owner.
- E. Provide all guarantees prior to final acceptance.
- F. Submit to Architect, all guarantees bound together, indexed and identified by specification section and equipment identification used in operating and maintenance data.
- G. Neither the final payment, nor occupancy by the Owner, nor Notice of Completion, shall be considered to relieve the Contractor of his responsibility for any materials or workmanship found to be defective, and he shall remedy any such defects and pay for damage to other work resulting from such defects, which may appear within the guarantee period.

END OF SECTION

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SECTION 01760

SPARE PARTS AND MAINTENANCE MATERIALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, material, tools, equipment, and services for all spare parts and maintenance materials as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.
5. See specification sections for items required.

PART 2 - PRODUCTS

2.01 SPARE PARTS AND TOOLS

A. Package in clearly identified boxes.

1. Indicate manufacturers name, part name and stock number.
2. Indicate what piece of equipment part or tool is for.
3. Indicate name, address and phone number of closest supplier.

2.02 MAINTENANCE MATERIALS

A. Package in clearly identified boxes.

1. Indicate trade name and stock number.
2. Indicate which item material is to be used with.
3. Indicate name, address and phone number of closest supplier.

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2.03 EXTRA MATERIALS

- A. Package in clearly identified containers, or install where indicated.
 - 1. Indicate trade name, stock number, size, color, etc.
 - 2. Indicate where product is to be used.
 - 3. Indicate name, address and phone number of closest supplier.

PART 3 - EXECUTION

3.01 DELIVERY

- A. Deliver to Owner at time of final completion, unless Owner requests earlier delivery.

END OF SECTION

SECTION 01810

BUILDING COMMISSIONING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.
- B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. 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 installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that O&M documentation left on site is complete.
 - 4. Verify that the Owner's operating personnel are adequately trained.

1.02 RELATED WORK

- A. Specific commissioning requirements are given in the following sections of these specifications. All of the following sections apply to the Work of this section.
 - 1. 01810 Commissioning Requirements: Describes the commissioning process and responsibilities.
 - 2. 01811 Mechanical Systems Commissioning: Describes systems, pre-functional and final testing and startup responsibilities of each including checklist forms.
 - 3. 01812 Electrical Systems Commissioning: Describes systems, procedures, testing and checklists.

1.03 ABBREVIATIONS

- A. The following are common abbreviations used herein.
 - 1. A/E: Architect and Design Engineers
 - 2. CA: Commissioning Authority
 - 3. CC: Controls Contractor
 - 4. CM: Construction Manager (the Owner's representative).

- 5. Cx: Commissioning
- 6. EC: Electrical Contractor
- 7. FT: Functional Performance Test
- 8. GC: General Contractor (prime)
- 9. MC: Mechanical Contractor
- 10. PC Pre-functional Checklist
- 11. PM: Project Manager (of the Owner)
- 12. Subs: Subcontractors to General
- 13. TAB: Testing, Adjusting and Balancing Contractor

1.04 DEFINITIONS

A. Following definitions apply to all Commissioning Activities:

- 1. "Contractor Start-Up" means sub-phase of Contractor's work ending with Acceptance of Work, during which Contractor performs a pre-planned program of activities including starting, testing, inspecting, adjusting, balancing, correcting Contract deficiencies, and other similar activities. During this period Commissioning Agent (CA) or his/her Representative shall be on site to observe, inspect and identify deficiencies in system operation.
- 2. "Completion of Startup" means when entire Work, including Contractor Startup and Fine Tuning, except those items arising from warranty provisions of Contract Documents, has been performed to requirements of Contract Documents and is so declared, in writing, by Commissioning Agent.
- 3. "Acceptance of Work" means when prerequisites to Acceptance of Work required by Contract Documents are fulfilled and Work is ready for use or is being used for purpose intended and state of work is so declared, in writing, by Owner.
- 4. "Fine Tuning" means sub-phase of Contractor's work, commencing after occupancy and ending twelve months later, during which Commissioning Agent identifies Contract deficiencies arising under normal operating conditions, after user occupancy, and Contractor corrects such Contract deficiencies.
- 5. "TAB" Contractor refers to the Test and Balance Contractor who is responsible for HVAC systems.

B. General:

- 1. Acceptance Phase: Phase of construction after startup 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 Mechanical and

Electrical sub-consultants who comprise the design team.

4. **Basis of Design:** The basis of design is the documentation of the approach and assumptions behind decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent.
5. **Commissioning Authority (CA):** The CA directs and coordinates the day-to-day commissioning activities.
6. **Commissioning Plan:** An overall plan 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):**
 - a. The Owner's representative in the day-to-day activities of construction to assist in the overall management of the project including supervising and on-site managing authority over a project's construction.
11. **Data Logging:** Monitoring flows, currents, status, pressures, etc. of equipment using standalone data loggers separate from the control system.
12. **Deferred Function Tests:** FTs 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 of 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 that are considered important to the Owner.
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. **Functional Performance Test (FT):** Test of the dynamic function and operation of

equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under (e.g. the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word, the primary work of TAB 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. Functional tests are performed after pre-functional checklists and startup is complete.

18. 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.
19. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
20. 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").
21. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
22. Non-Compliance: See Deficiency.
23. Non-Conformance: See Deficiency.
24. 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."
25. Owner-Contracted Tests: Tests paid for by the Owner outside the GC's contract and for which the CA does not oversee. These tests will not be repeated during functional tests if properly documented.
26. Phased Commissioning: Commissioning that is completed in phases (by floors or areas, for example) due to the size of the structure or other scheduling issues, in order to minimize the total construction time.
27. Pre-functional Checklist (PC): A list of items to inspect and elementary component tests to conduct before final functional testing to verify proper installation of equipment, provided by the CA. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK labels affixed, gauges in place, sensors calibrated,

etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system. Pre-functional checklists augment and are combined with the manufacturer's startup checklist.

The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the pre-functional checklists, except for larger or more critical pieces of equipment.

28. Project Manager (PM): The contracting and managing authority for the Owner over the design and/or construction of the project.
29. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment. Refer to Section 01810, part 3 for details.
30. Seasonal Performance Tests: Functional test which are deferred until the system(s) will experience conditions closer to their design conditions.
31. 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.
32. Specifications: The construction specifications of the Contract Documents.
33. Startup: The initial starting or activating of dynamic equipment, including executing pre-functional checklists.
34. Subs: The subcontractors to the GC who provide and install building components and systems.
35. Test Procedures: The step-by-step process that must be executed to fulfill the test requirements. The CA will develop the test procedures.
36. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are specified in the Contractor Documents.
37. Trending: Monitoring using the building control system.
38. Vendor: Supplier of equipment.
39. 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.

1.05 COORDINATION

- A. Commissioning Team: The members of the commissioning team consist of the Commissioning Authority (CA), the Project Manager (PM), the General Contractor (CG), the Architect and Design Engineers (A/E), the Mechanical Contractor (MC), the Electrical

Contractor (EC), the TAB representative (TAB), the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. The Owner's building or plant operator/engineer is also a member of the commissioning team.

Management: Hired by the Owner, the CA directs and coordinates the commissioning activities. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. Refer to Section 01810 Part 1 for additional management details.

- B. Scheduling: The CA will work with the GC according to established protocols to schedule the commissioning activities. The CA will provide notice to the GC 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.
- C. The CA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The *Commissioning Plan* provides a format for this schedule. As construction progresses the CA will develop more detailed schedules. The Commissioning Plan also provides a format for detailed schedules.

1.06 COMMISSIONING PROCESS

- A. Commissioning Plan: The commissioning plan provides guidance in the execution of the commissioning process. The CA will issue the plan, although it will continue to evolve and expand as the project progresses. 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 construction and the general order in which they occur.
 - 1. Commissioning during construction begins with a scoping meeting conducted the CA where the commissioning process is reviewed with the commissioning team members.
 - 2. Additional meetings will be required throughout construction, scheduled by the CA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 - 3. Equipment documentation is submitted to the CA during normal submittals, including detailed startup procedures.
 - 4. The CA works with the Subs in developing startup plans and startup documentation formats, including providing the pre-functional checklists to be completed by the appropriate Subs, during the startup process in conjunction with any additional startup forms used by the Subs.
 - 5. In general, the checkout and performance verification proceeds from simple to

6. The Subs, under their own direction, executed and document the pre-functional checklists and perform startup and initial checkout. The CA documents that the checklists and startup were completed according to the approved plans. This may include the CA witnessing startup of selected equipment.
7. The CA develops specific equipment and system functional performance test procedures. The Subs review the procedures.
8. The procedures are executed by the Subs, under the direction of, and documented by the CA.
9. Items of non-compliance in material, installation or setup are corrected at the Sub's expense and the system retested.
10. Commissioning is completed before Substantial Completion.
11. The CA reviews, pre-approved and coordinates the training provided by the Subs, and verifies that it was completed.
12. Deferred testing is conducted, as specified or required.

1.07 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the mechanical contractor, TAB and controls contractor are in Section 01811 and those of the electrical contractor in Section 01812 and those of this Section. It is noted that the services for the Project Manager, Construction Manager, Architect, HVAC Mechanical and Electrical Designers/Engineers, and Commissioning Authority are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.
- B. All Parties:
 1. Follow the Commissioning Plan.
 2. 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 CA.
 - 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:
1. Construction and acceptance Phase:
- a. Perform normal submittal review, construction observation, as-built, drawing preparation, etc., as contracted.
 - b. Provide any design narrative, (Basis of Design) and sequences documentation requested by the CA. 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. Provide a presentation at one of the training sessions for the Owner's personnel.
 - g. Review the pre-functional checklists for major pieces of equipment for sufficiency prior to their use.
 - h. Witness testing of selected pieces of equipment and systems.
- E. Commissioning Authority (CA):
1. The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction

2. Construction and Acceptance Phase:

- a. Coordinates and directs the commissioning activities in a logical sequential an efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties.
- b. Coordinate the commissioning work and, with the GC and CM, ensure that commissioning activities are being scheduled into the master schedule.
- c. Develop the Commissioning Plan.
- d. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
- e. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor startup and checkout procedures.
- f. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
- g. Review normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
- h. Write and distribute pre-functional checklists.
- i. Develop an enhanced startup and initial systems checkout plan with Subs.
- j. Perform site visits, as necessary, to observe component, system installations, and testing. Attend selected planning and job site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
- k. Approve pre-functional checklist completion by reviewing pre-functional checklist reports and by selected site observation and spot checking.
- l. Approve systems startup by reviewing startup reports and by selected site

observations.

- m. Review TAB execution plan.
- n. Witness sufficient functional testing of the control system and approve it to be used for TAB, fore TAB is executed.
- o. Approve air and water system balancing by reviewing completed reports and by selected site observation.
- p. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include energy management control system trending, standalone data logger monitoring or manual functional testing.
- q. Analyze any functional performance trend logs and monitoring data to verify performance.
- r. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved. Perform actual functional testing without contractors on equipment so specified in Sections 01811 and 01812.
- s. Maintain a master deficiency and resolution log and a separate testing record. Provide the CM with written progress reports and test results with recommended actions.
- t. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
- u. Oversee and approve the training of the Owner's operating personnel.
- v. Compile and maintain a commissioning record.
- w. Review the preparation of the O&M manuals.
- x. Provide a final commissioning report (as described in this section).

3. Warranty Period:

- a. Coordinate and witness required seasonal or deferred testing and deficiency corrections.

F. Construction Manager – Owner's Representative (CM):

1. Construction and Acceptance Phase:

- a. Facilitate the coordination of the commissioning work by the CA, and, with the GC

and CA, ensure that commissioning activities are being scheduled into the master schedule.

- b. Provide Owner's Project Requirements (OPR)
 - c. Review and approve the final *Commissioning Plan*.
 - d. Attend a commissioning scoping meeting and other commissioning team meetings.
 - e. Perform the normal review of Contractor submittals.
 - f. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA.
 - g. Review and approve the functional performance test procedures submitted by the CA, prior to testing.
 - h. When necessary, observe and witness pre-functional checklists, startup and functional testing of selected equipment.
 - i. Review commissioning progress and deficiency reports.
 - j. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
 - k. Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the Project Manager.
 - l. Assist the GC in coordinating the training of Owner personnel.
2. Warranty Period: Assist the CA 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 when scheduled.
 2. Commissioning Plan: Provide final approval for the completion of the commissioning work.

3. Warranty Period: Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

H. General Contractor (GC):

1. Construction and Acceptance Phase:
 - a. Facilitate the coordination of the commissioning work by the CA, and with the GC and CA ensure that commissioning activities are being scheduled into the master schedule.
 - b. Include the complete cost of commissioning in the total contract price and ensure that all Subs have budgeted for their required level of involvement.
 - c. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA.
 - d. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
 - e. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
 - f. Provide materials and services to accomplish the commissioning scope of work for the mechanical and electrical systems furnished and installed as a part of this contract.
 - g. Provide pre-functional and functional testing under the supervision of the Commissioning Agent, including preparation of data in form templates.
 - h. Provide qualifying calibrated instrumentation needed for the prescribed testing procedures. Provide the services of specialized technicians when required for certain tests and/or validation efforts. These services may come from the vendors of the equipment to be tested or from qualified independent testing services.
 - i. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
 - j. Coordinate the training of Owner personnel.
 - k. Prepare 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,

witnessed by the CA, according to the specifications.

- 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.

I. Equipment Suppliers:

1. Provide all requested submittal data, including detailed startup 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 and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for standalone data logging equipment that may be used by the CA.
4. Through the contractors they supply products to, analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.
5. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
6. Review test procedures for equipment installed by factory representatives.

1.08 SUBMITTALS

- A. Submit draft and final contractor start-up report forms as described in part 3 of this section.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all testing equipment required by the Commissioning Process. Testing equipment shall be provided by the Contractor responsible for the item or system being tested. Mechanical contractor shall provide test equipment for HVAC and plumbing systems, except for equipment required by the Testing, Adjusting and Balancing contractor (TAB). Electrical contractor shall provide test equipment for electrical systems.
- B. Provide any special equipment, tools, and instruments, only available from vendor and specific to a piece of equipment, required for the commissioning process. This equipment shall remain on site and become property of the Owner after commissioning.

- C. Testing equipment shall be of sufficient quality and accuracy to test and measure to the tolerances specified. The following minimum requirements apply unless otherwise indicated.
1. Temperature sensors and digital thermometers: An accuracy of 0.5°F, resolution of $\pm 0.1^\circ\text{F}$ with a NIST certified calibration in the past year.
 2. Pressure sensors: An accuracy of $\pm 0.2.0\%$ of the value range being measured.
 3. Calibrated tags shall be affixed, or certificates of calibration shall be readily available.

PART 3 – EXECUTION

3.01 CONTRACTOR START-UP REPORT FORMS

- A. Prepare and submit one copy of report forms to be used in preparation of system reports for following:
1. Each mechanical system specified in Section 01811.
 2. Each electrical system specified in Section 01812.
- B. Each system report shall include following:
1. Project name.
 2. Name of system.
 3. Index of report's content.
 4. List of equipment in system.
 5. Adjacent to list of equipment, columns to indicate status of equipment operation, to date and to sign off equipment start-up.
 6. Space to record equipment and operational problems which cannot be corrected within scheduled Contractor Start-Up program, and which may delay Acceptance of Work.
 7. Manufacturers' equipment start-up reports.
 8. Systems' testing, balancing, and adjusting reports.
 9. Equipment report forms, which shall include:

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Project #0901.00

- a. Project name.
 - b. Name of equipment.
 - c. Starting and testing procedures to be performed.
 - d. Observations and test results to be recorded.
- C. Submittals:
1. Submit draft report forms for Commissioning Agent's review and comment prior to final submission. Coordinate draft submissions with Commissioning Agent.
 2. Submit final report forms, acceptable to Commissioning Agent not later than twelve weeks before scheduled date of Acceptance of Work.

3.02 PRE-FACILITY START-UP MEETINGS

- A. Pre-Facility Start-Up meetings shall be held from start of Work until Contractor Start-Up schedules and Contractor Start-Up report forms have been approved by Commissioning Agent.
- B. Purpose: To monitor development of Contractor Start-Up schedule and Contractor Start-Up report forms.
- C. Frequency: As directed by Commissioning Agent until Contractor Start-Up schedule and Contractor Start-Up report forms are approved by Commissioning Agent.
- D. Location: Contractor's site office or other on-site location agreed to between Commissioning Agent and Contractor.
- E. Attendees:
 1. Contractor's Representatives: Contractor's site superintendent, mechanical and electrical subcontractors, and when so requested by Commissioning Agent, Sub-subcontractors, suppliers and other parties involved in Work. Contractor's representatives shall be qualified and authorized to act on behalf of party each represents.
 2. Commissioning Agent's representatives.
- F. Agenda:
 1. Review of progress of Contractor Start-Up schedule preparation.
 2. Review of progress of Contractor Start-Up report form preparation.
 3. Identification of problems impeding progress.

4. Other business.

G. Minutes: Contractor shall record minutes and distribute copies to all attendees within seven days after meeting.

3.03 FACILITY START-UP PROGRESS MEETINGS

A. Facility start-up progress meetings shall be held during Contractor Start-Up.

B. Purpose: To monitor Contractor Start-Up progress and to identify problems and action required for their resolution, to expedite Contractor Start-Up.

C. Frequency: Every two weeks or as otherwise directed by Commissioning Agent.

D. Location: Same as pre-Facility Start-Up meetings.

E. Attendees: Same as pre-Facility Start-Up meetings.

F. Agenda:

1. Review of Contractor Start-Up progress.

2. Identification of problems impeding progress towards achievement of Contractor Start-Up milestones.

3. Review of outstanding Contract deficiencies.

4. Review of Change Orders and Requests for Proposals.

5. Other business.

G. Minutes: Same as Pre-Facility Start-Up meetings.

3.04 FACILITY START-UP

A. Contractor Responsibilities During Facility Start-Up (Not necessarily in order listed):

1. Start equipment and systems as specified in Sections 01811 and 01812.

2. Test, adjust and balance equipment and systems as specified in Sections 01811 and 01812.

3. Demonstrate equipment and systems as specified in Sections 01811 and 01812.

4. Complete and submit Contractor Start-Up reports including:

a. Contractor's system and equipment start-up reports.

- b. Testing, adjusting and balancing reports.
 - c. Manufacturers' equipment start-up reports.
 - 5. Review Contract Documents and inspect Work to ensure completeness of Work and compliance with requirements of Contract Documents.
 - 6. Correct Contract deficiencies identified as a result of foregoing and as may be identified by Owner.
 - 7. Execute Change Orders issued by Owner.
 - 8. Perform other work and activities required for fulfillment of prerequisites to Acceptance of Work.
- B. Commissioning Agent Responsibilities during Facility Start-Up.
 - 1. Carry out pre-interim inspections as necessary.
 - 2. Witness manufacturers' equipment start-up.
 - 3. Verify starting, testing, adjusting and balancing by Contractor.
 - 4. Review and approve Contractor Start-Up reports.
 - 5. Cooperate in systems and equipment demonstration and instruction.
- C. Owner Responsibilities during Facility Start-Up.
 - 1. Initiate Change Orders as required.
 - 2. Verify correction of Contract deficiencies by Contractor.
 - 3. Verify execution of Change Orders by Contractor.
- D. Ongoing Cycle of Facility Start-Up Includes:
 - 1. Commissioning Agent's inspections.
 - 2. Documentation of results.
 - 3. Diagnosis of problems.
 - 4. Correction of Contract deficiencies and execution of Change Orders as required.
 - 5. Verification of results.

3.05 FINE TUNING

- A. Fine tuning will commence upon Acceptance of Work.
- B. Contractor Responsibilities During Fine Tuning:
 - 1. Correct Contract deficiencies previously outstanding and those identified during Fine Tuning.
 - 2. Execute Change Orders issued by Owner.
 - 3. Where Contractor startup has been properly implemented construction and design deficiencies left to be resolved during this period should be relatively minor.
 - a. Ensure expedient correction of minor problems which are identified during initial occupancy.
 - b. Attend regular weekly meetings with Building Manager and Building Engineer to review any operational problems.
 - c. Make necessary environmental measurements and survey users to quickly identify problems and establish necessary trade inputs for resolution.
 - d. Monitor and manage prompt correction of Contract deficiencies identified during initial user occupancy.
 - e. Find and eliminate deficiencies in systems and equipment performance.
 - f. Complete work on all fine tuning issues within first 12 months from the date of completion.
- C. Commissioning Agent Responsibilities During Fine Tuning:
 - 1. Carry out a series of systems and equipment operating tests under conditions simulating, to extent possible, full and partial operating loads.
 - 2. Record test results.
 - 3. Diagnose problems.
 - 4. Repeat tests as required following correction of Contract deficiencies and execution of Change Orders by Contractor and verify results.
- D. Ongoing Cycle of Fine Tuning Includes:
 - 1. Performance testing.
 - 2. Documentation of results.

3. Diagnosis of problems.
4. Correction of Contract deficiencies and execution of Change Orders as required.
5. Verification of results.

3.06 CONTRACT ACCEPTANCE PROCESS

A. Process for Owner's Acceptance of Work:

1. Acceptance of Work:
 - a. Fulfillment of prerequisites to Acceptance.
 - b. Inspection for Acceptance.
 - c. Issuance of Letter of Acceptance.
2. Completion of Fine Tuning:
 - a. Fulfillment of prerequisites to Completion of Fine Tuning.
 - b. Inspection for Completion of Fine Tuning.
 - c. Issuance of Letter of Completion of Fine Tuning.

3.07 PARTIAL ACCEPTANCE OF WORK: When partial utilization of Work is required and Acceptance of Work is a condition of such partial utilization, applicable requirements specified in this Section shall apply to parts of Work to be utilized.

3.08 PREREQUISITES TO ACCEPTANCE

- A. Following to be completed prior to requesting Owner's inspection for Acceptance.
- B. Perform Contractor Start-Up Activities.
 1. Obtain and submit evidence of compliance with regulatory requirements as specified, including following:
 - a. Occupancy permits.
 - b. Inspection/operating certificates.
 2. Remove from Project site temporary facilities as specified, along with construction tools, equipment, and mock-ups and similar items.
 3. Complete starting of systems and equipment as specified.

4. Complete testing, adjusting and balancing of systems and equipment as specified.
5. Complete equipment and systems demonstration and instruction as specified.
6. Complete final cleaning as specified.
7. Submit Project Record Documents as specified.
8. Submit operation and maintenance data as specified.
9. Provide spare parts and maintenance materials as specified.
10. Submit product warranties and certificates of assurance as specified.
11. Make final change-over of locks and transmit keys to Owner as specified.
12. Ensure Work is ready for use for purpose intended.
13. Review Contract Documents and inspect Work to confirm that prerequisites to Acceptance of Work have been fulfilled and that Work is ready for inspection for Acceptance.

3.09 INSPECTION FOR ACCEPTANCE

- A. Submit written request to Owner for inspection for Acceptance of Work, certifying prerequisites specified have been fulfilled and indicating known exceptions in list of items to be completed, corrected or submitted.
- B. Owner will, within a reasonable time after receipt of Contractor's request, proceed with inspection, or advise Contractor prerequisites are not adequately fulfilled.
- C. Results of Owner's inspection for Acceptance will form initial Contract deficiency list.

3.10 ACCEPTANCE OF WORK

- A. Following inspection, Owner will:
 1. Issue a Letter of Acceptance stating effective date of Acceptance of Work, with a copy of Contract Deficiency list attached thereto, or
 2. Advise Contractor that prerequisites to Acceptance are not fulfilled and repeat inspection for Acceptance as necessary.
- B. Upon issuance of Letter of Acceptance, Owner will assume responsibility for care, custody and control of Work, including responsibility for:
 1. Facility operation, including all systems and equipment.

2. Maintenance.
3. Security.
4. Property insurance.
5. Utility costs.

3.11 PREREQUISITES TO COMPLETION OF START-UP FINE TUNING

A. Prerequisites to Completion of Fine Tuning Work are:

1. Prior Acceptance of Work.
2. Completion of Fine Tuning activities by Commissioning Agent and Contractor as specified.
3. Contract deficiencies identified during Fine Tuning testing and previously identified but outstanding Contract deficiencies shall have been corrected by Contractor or addressed adequately by Contractor so course of action can be established by Commissioning Agent.
4. Ensure entire work, except items arising from warranty provisions of Contract Documents, has been performed to requirements of Contract Documents.

3.12 INSPECTION FOR COMPLETION OF START-UP FINE TUNING

A. Submit written request to Owner for inspection, including copy of Owner's most recent Contract Deficiency list, certifying each Contract deficiency has been corrected or otherwise resolved in a manner agreed to between Owner and Contractor.

1. List known exceptions, if any, in request.

B. Owner will within a reasonable time after receipt of Contractor's request:

1. Proceed with inspections, or
2. Advise Contractor prerequisites are not adequately fulfilled.

C. Following inspection, Owner will:

1. Issue a Letter, stating effective date of completion of start-up Fine Tuning.
2. Advise Contractor of Contract deficiencies to be corrected prior to issuance of Letter completion of start-up Fine Tuning.

3.13 SUBMITTALS

- A. The CA will provide appropriate contractors with a specific request for the type of submittal documentation the CA requires in facilitating the commissioning work. These requirements 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 detailed startup procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of Owner contracted tests. In addition, the installation checkout materials that are actually shipped inside the equipment and the actual field checkout street forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority. All documentation required by the CA will be included by the Subs in their O&M contributions.
- B. The Commissioning Authority will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the function 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 Commissioning Authority 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 CA 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 CA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CA will review and approve them.

3.14 PHASED COMMISSIONING (IF APPLICABLE)

- A. The project may require startup and initial checkout to be executed in phases. This phasing will be planned and scheduled in a coordination meeting of the CA, CM, GC and the Mechanical, TAB, Controls Contractors. Results will be added to the master and commissioning schedule.

3.15 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation: The CA shall witness and document the results of functional performance tests using the specific procedural forms. Prior to testing, these forms are provided to the CM for review and approval and to the Subs for review.
- B. Non-Conformance:
 - 1. The CA 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 a

standard non-compliance form.

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. 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 CA is not obligated to overlook 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 test progress and a deficiency are identified, the CA 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) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy give to the CM and to the Sub representative assumed to be responsible.
 - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - 1) The deficiency shall be documented on the non-compliance form 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. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/e. Final acceptance authority is with the Project Manager.
 - 3) The CA 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 CA. The CA reschedules the test and the test is repeated until satisfactory performance is achieved.

5. Cost of Retesting:

- a. The cost for the Sub to retest a pre-functional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 - b. For a deficiency identified, not related to any pre-functional checklist or startup fault, the following shall apply. The CA and CM will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CA's and CM's time for a second retest will be charged to the GC, who may choose to recover the costs from the responsible Sub.
 - c. The time for the CA and CM to direct any retesting required because a specific *pre-functional* checklist or startup test 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 part responsible for executing the faulty pre-functional test.
 - d. Refer to the sampling section of Part 3.06 of this Section for requirements for testing and retesting identical equipment.
6. The Contractor shall response in writing to the CA 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 CA retains the original non-conformance forms until the end of the project.
8. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.

3.16 OPERATION AND MAINTENANCE MANUALS

A. Submission by Contractor(s):

1. Submit three typed and bound copies of Operating and Maintenance (O&M) Manuals prior to scheduling systems demonstrations for the Owner's Representative.
2. Bind each Maintenance Manual in one or more vinyl covered, 3-ring binders, with pockets for folded drawings.
 - a. Mark the spine of each binder with system identification and volume number.

B. Required Contents:

1. Manuals shall have index with tab dividers for each major equipment section to facilitate locating information on a specific piece of equipment.
 2. Identify data within each section with drawing code numbers as they appear on Drawings. Include as a minimum the following data:
 - a. Alphabetical list of system components, with the name, address and 24 hour telephone number of the company responsible for servicing each item during the first year of operation. Include point of contact for company.
 - b. Operating instructions for complete system including:
 - 1) Emergency procedures for fire and failure of major equipment.
 - 2) Major start, operation and shut down procedures.
 - c. Maintenance Instructions for Each Piece of Equipment Including:
 - 1) Equipment lists.
 - 2) Proper lubricants and lubricating instructions for each piece of equipment.
 - 3) Necessary cleaning, replacement and/or adjustment schedule.
 - 4) Product data.
 - 5) Installation instructions.
 - 6) Parts list.
 - 7) Temperature control diagrams and O&M information as specified above.
 - d. Marked or changed prints locating concealed parts and variations from the original system design (as-built drawings).
 - e. Balancing report.
 - f. Valve schedule and associated piping schematics.
 - g. Copies of any extended equipment warranties which are greater than one year.
- C. A/E Contribution: The A/E will include in the beginning of the O&M manuals a separate section containing an updated design intent narrative to reflect as-built status.

- D. CA Review: Prior to substantial completion, the CA shall review the O&M manuals, documentation and redline as-builts for *systems that were commissioned*. The CA will communicate deficiencies in the manuals to the CM, PM or A/E, as requested. The CA 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.
- E. Commissioning Record in O&M Manuals:
1. The CA is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it the GC, to be included with the O&M manuals. Three copies of the manuals will be provided. The format of the manuals shall be:
 - a. Tab 1-1: Commissioning Plan.
 - b. Tab 1-2: Final Commissioning Report (see E.2 below).
 - c. Tab 01: System Type 1 (packaged unit, exhaust fans, boiler system, etc.)
 - 1) Sub-Tab A; Submittals of approved equipment.
 - 2) Sub Tab B: Startup plan and report, manufacturer's installation instructions, blank pre-functional checklists.
 - 3) Sub Tab C: Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended re-commissioning schedule.
 - 4) Use Separator Sheets – for each equipment type (fans, pumps, chiller, etc.)
 - d. Tab 02: System Type 2 – repeat as per System Type 1.
 - e. Tab 03 to Tab XX: Continue for all System Type – repeat as per System Type 1.
 2. Final Report Details: The final commissioning report shall include an executive summary, 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 disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Future actions,

commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

3. The CA will retain other documentation.

3.17 WARRANTIES

- A. The warranty period is one year after Date of Acceptance.

1. During this period, provide labor and materials as required to repair or replace defects in the mechanical system at no additional cost to the Owner. Provide certificate with O&M Manual submittal, which guarantees same-day service response to Owners call for all such warranty service.
2. Provide certificate for such items of equipment, which have warranties in excess of one year. Insert copies in O&M Manuals.
3. Provide extended manufacturers warranties to cover one full year from date of acceptance if standard warranty starts any time prior to that date.
4. Provide factory trained service personnel for all warranty work on the Building Automation and Automatic Temperature Control System.

3.18 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 CA shall be responsible for overseeing the content and adequacy of the training of Owner personnel for commissioned equipment.
 1. The CA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CA shall decide how rigorous the training should be for each piece of commissioned equipment. The CA shall communicate the results to the Subs and vendors who have training responsibilities.
 2. For the primary HVAC equipment, the Controls Contractor shall provide a discussion of the control of the equipment during the mechanical or electrical training conducted by others.
 3. The CA develops an overall training plan and coordinates and schedules, with the CM and GC, the overall training for the commissioned systems. The CA develops criteria for determining that the training was satisfactorily

completed, including attending some of the training, etc.

4. The Owner may provide videotaping of the training sessions and the tapes added to the O&M manuals.
5. The mechanical design engineer shall at the first training session present the overall system design concept.

3.19 DEFERRED TESTING

- A. **Unforeseen Deferred Tests:** 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.

END OF SECTION

SECTION 01811

MECHANICAL SYSTEM COMMISSIONING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This specification covers the startup, operating performance test and commissioning of the building mechanical systems described herein.
- B. The Mechanical Contractor and the General Contractor shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to accomplish the work and labor and material for execution, monitoring and printing data forms necessary to verify and record system observations.
- C. The Test and Balance Contractors shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to execute and accomplish the work.
- D. At the completion of the startup, operations performance test and test and balance, the Contractor shall conduct a 72 hour dynamic mode demonstration of the systems in the presence of the Owner/Architect/Engineer and CA.
- E. The list of equipment and/or systems to be commissioned for the building under the base bid is as follows:
 - 1. Exhaust Fans EF-1 thru EF-9.
 - 2. Rooftop Packaged Unit AC-1 thru AC-6.
 - 3. Split System Indoor Cooling Only Units FC-1 and FC-2.
 - 4. Split System Outdoor Condensing Unit CU-1 and CU-2.
 - 5. Gas-Fired Water Heater WH-1.
 - 6. Domestic Hot Water Circulating Pump CP-1.

1.02 RELATED WORK

- A. The requirements of the General Conditions, Supplemental Conditions, Section 01810 apply to all work specified in this section.

1.03 RESPONSIBILITIES

- A. Mechanical, Controls and TAB Contractors: The commissioning responsibilities applicable to each of the mechanical, controls, and TAB contractors are as follows (all references apply to commissioned equipment only):

1. Construction and Acceptance Phases:
 - a. Include and itemize the cost of commissioning in the contract price.
 - b. In each purposed order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 - c. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
 - d. Contractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned equipment.
 - e. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA 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 full details of any owner-contracted tests, fan and pump curves, full factory testing reports, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up 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 Commissioning Agent.
 - 2) The Commissioning Agent may request further documentation necessary for the commissioning process.
 - 3) This data request may be made prior to normal submittals.
 - f. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review and approval.
 - g. Contractors shall assist (along with the design engineers) 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.
 - h. Provide limited assistance to the CA in preparing the specific functional performance test procedures as specified herein. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

- i. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists form the CA for all commissioned equipment. Submit to CA for review and approval prior to start-up. Refer to Section 01810 for further details on start-up plan preparation.
 - j. During the start-up and initial checkout process, execute the mechanical related portions of the prefunctional checklists for all commissioned equipment.
 - k. Perform and clearly document all completed start-up and system operational checkout procedures, providing a copy to the CA.
 - l. Address current A/E punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air or water related systems.
 - m. 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 test, adjustments and problem solving.
 - n. Provide skilled technicians to perform functional performance testing under the direction of the CA for specified equipment herein and in Section 01810. Assist the CA in interpreting the monitoring data, as necessary.
 - o. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, CM and A/E and retest the equipment.
 - p. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences to as-built conditions.
 - q. During construction, maintain as-built reline drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
 - r. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
 - s. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
2. Warranty Period:
- a. Execute seasonal or deferred functional performance testing.

- b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified during testing.
- B. Mechanical Contractor: The commissioning responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:
 1. Provide startup for all HVAC equipment, except for the building automation control system.
 2. Assist and cooperate with the TAB contractor and CA by:
 - a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - b. Including cost of sheaves and belts that may be required by TAB.
 - c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.
 - d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
 3. Install a P/T plug at each water sensor that is an input point to the control system.
 4. List and clearly identify on the as-built drawings the locations of all airflow stations.
 5. Prepare a preliminary schedule for pipe and duct system testing flushing and cleaning, equipment start-up and TAB start and completion for use by the CA. Update the schedule as appropriate.
 6. Notify the CM and CA, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the CM and CA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.
- C. Controls Contractor: The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:
 1. Sequences of Operation Submittals: The Control Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the Specifications. They shall include:

- a. An overview narrative of the system of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
- b. All interactions and interlocks with other systems.
- c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
- d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
- e. Start-up sequences.
- f. Warm-up mode sequences.
- g. Normal operating mode sequences.
- h. Unoccupied mode sequences.
- i. Shutdown sequences.
- j. Capacity control sequences and equipment staging.
- k. Temperature and pressure control: Setbacks, setups, resets, etc.
- l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
- m. Effects of power or equipment failure with all standby component functions.
- n. Sequences for all alarms and emergency shut downs.
- o. Seasonal operational differences and recommendations.
- p. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
- q. Schedules.
- r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

2. Control Drawings Submittal:
 - a. The control drawings shall have a key to all abbreviations.
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - d. Provide a full points list with at least the following included for each point:
 - 1) Controlled system.
 - 2) Point abbreviation.
 - 3) Point description.
 - 4) Display unit.
 - 5) Control point or setpoint (Yes/No).
 - 6) Monitoring point (Yes/No).
 - 7) Intermediate point (Yes/No).
 - 8) Calculated point (Yes/No).
 - 9) Key:
 - a) Point description: DB temp, airflow, etc.
 - b) Control or setpoint: Point that controls equipment and its setpoint changed (OSA, SAT, etc.)
 - c) Intermediate point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
 - d) Monitoring point: point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
 - e) Calculated point: "Virtual" point generated from calculations of other point values.
 - f) The Controls Contractor shall keep the Ca informed of all changes to this list during programming and setup.
3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
4. Assist and cooperate with the TAB contractor in the following manner:
 - a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).

- b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CA prior to TAB.
 - c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
 5. Assist and cooperate with the CA in the following manner:
 - a. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system as specified for the controls contractor herein and Section 01812. Assist in the functional testing of all equipment specified herein and Section 01812. Provide two-way radios during the testing.
 - b. Execute all control system trend logs specified herein and Section 01812.
 6. Provide a signed and dated certification to the CA and CM upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements. Provide completed field checkout forms to the CA.
 7. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
- D. TAB Contractor: The duties of the TAB Contractor, in addition to those listed in (A) are:
 1. Six weeks prior to starting TAB, submit to the CM the qualification of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Owner will approve the site technician's qualifications for this project.
 2. Submit the outline of the TAB plan and approach for each system and component to the CA, CM and the Controls Contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.
 3. The submitted plan will include:
 - a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
 - b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.

- c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
- d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
- e. Final test report forms to be used.
- f. Detailed step-by-step procedures for TAB work for each system and issue: Terminal flow calibration (for each terminal type), diffuser proportioning, branch/submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.
- g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters and formulas to be used.
- h. Details of how total flow will be determined (Air: Sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply air (SA) and return air (RA) traverse, SA or RA flow stations. Water: Pump curves, circuit setter, flow station, ultrasonic, etc.).
- i. The identification and types of measurement instruments to be used and their most recent calibration date.
- j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
- k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.
- l. Details of whether and how minimum outside air cfm will be verified and set, for what level (total building, zone, etc.).
- m. Details of how building static and exhaust fan/relief damper capacity will be checked.
- n. Proposed selection points for sound measurements and sound measurement methods.
- o. Details of methods for making any specified coil or other system plant capacity measurements.

- p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
 - q. Details regarding specified deferred or seasonal TAB work.
 - r. Details of any specified false loading of systems to complete TAB work.
 - s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - t. Details of any required interstitial cavity differential pressure measurements and calculations.
 - u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - v. Plan for formal progress reports (scope and frequency).
 - w. Plan for formal deficiency reports (scope, frequency and distribution).
- 4. The tab field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CA and CM at least twice a week.
 - 5. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect the control system setup and operation.
 - 6. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC.
 - 7. Provide the CA with any requested data, gathered, but not shown on the draft reports.
 - 8. Provide a final TAB report for the CA with details, as in the draft.
 - 9. Conduct functional performance tests and checks on the original TAB as specified for TAB herein.
- E. Mechanical Designer: Refer to Section 01810 for the responsibilities of the mechanical designer.

1.04 COMMISSIONED SYSTEMS (List Systems)

- A. All mechanical equipment scheduled on sheets labeled "M" and "P" are to be included as part of the commissioning effort.

1.05 RELATED WORK

- A. Refer to Section 01810, Part 1 for a listing of sections where commissioning requirements are found.

PART 2 – PRODUCTS

2.01 MATERIALS, LABOR, INSTRUMENTS, TOOLS, LADDERS AND APPARATUS

- A. The Contractor shall provide all materials, labor, instruments, tools, ladders and apparatus necessary to startup, perform operating performance test and systems conditioning.
- B. The Contractor shall be responsible for maintaining the commissioning documentation until final acceptance of the project. The checklists in appendix one are samples for bidding purposes. Final checklists will be produced by the CA and provided prior to beginning commissioning. The commissioning documentation shall be kept current by the Contractor and shall be available for inspection at all times. At the time of acceptance of the project, the Contractor shall surrender 3 complete copies of the commissioning documentation to the Owner's representative.

2.02 TEST EQUIPMENT

- A. Mechanical Contractor shall provide test equipment necessary to fulfill the testing requirements of this Division.

PART 3 – EXECUTION

3.01 SUBMITTALS

- A. Submittal documentation relative to commissioning as required in this Section, Part 1, and Section 01810.

3.02 STARTUP

- A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Section 01810. Mechanical Contractor has start-up responsibility and is required to complete systems and subsystems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not

relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or subsystems at the discretion of the CA and CM. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.03 TAB

- A. Refer to the TAB responsibilities in Part 1 above.

3.04 FUNCTIONAL PERFORMANCE TESTS

- A. Refer to Section 01810, Part 1 for a list of systems to be commissioned and to Part 3 for a description of the process and herein for specific details on the required functional performance tests.

3.05 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Refer to Section 01810, Part 3 for specific details on non-conformance issues relating to prefunctional checklists and tests.
- B. Refer to Section 01810, Part 3 for issues relating to prefunctional tests and startup.

3.06 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in the Specifications.
- B. Mechanical Contractor shall compile and prepare documentation for equipment and systems and deliver his documentation to the GC for inclusion in the O&M manuals, according to this section and Section 01810, prior to the training of Owner personnel.
- C. The CA shall receive a copy of the O&M manuals for review.
- D. Special TAB Documentation Requirements: The TAB will compile and submit the following with other documentation that may be specified elsewhere in the Specifications.
- E. Final report containing and explanation of this methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon, abbreviations and column headings.
- F. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

- G. **Reviews:** Review of the commissioning related sections of the O&M manuals will be conducted by the A/E and by the CA. Refer to Section 01810, Part 3 for details.

3.07 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01810 for additional details.
- B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment or systems. Refer to Section 01810 for additional details.
- C. **Mechanical Contractor:** The mechanical contractor shall have the following training responsibilities:
 - 1. Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 01810, Part 3.
 - 2. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure etc.
 - 3. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of each modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
 - 4. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate wherever possible the use of the O&M manuals for reference.
 - 5. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for the pieces of equipment.
 - 6. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 - 7. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.
 - 8. **Duration of Training:** The mechanical contractor shall provide training on each piece of equipment, with a minimum time of (1) one hours for each piece of equipment.

- D. Controls Contractor: The controls contractor shall have the following training responsibilities:
1. Provide the CA with a training plan four weeks before the planned training according to the outline described in Section 01810, Part 3.
 2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.
 3. The trainers will be knowledgeable on the system and its use in the buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.
 4. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 5. There shall be at least one training session on the Building Systems. The session shall be held on-site for a period of four (4) hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
 - a. Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing set-points and alarms and other typical changed parameters, overrides, manual operation of equipment, optional control strategies that can be considered, energy saving strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. All trending and monitoring features (values, change of state, totalization, etc.) including setting up, executing, downloading, viewing both tabular and graphically printing trends. Trainees will actually set-up trends in the presence of the trainer.
 - d. Every screen shall be completely discussed, allowing time for questions.
 - e. Use of keypad or plug-in laptop computer at the zone level.
 - f. Use of remote access to the system via phone lines or networks.
 - g. Setting up and changing an air terminal unit controller.

- h. Graphics generation.
- i. Point database entry and modifications.
- j. Understanding DDC field panel operating programming (when applicable).

E. TAB: The TAB contractor shall have the following training responsibilities:

1. TAB shall meet for two (2) hours with facility staff after completion of TAB and instruct them on the following:
 - a. Go over the final TAB report, explaining the layout and meanings of each data type.
 - b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 - c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - e. Other salient information that may be useful for facility operations, relative to TAB.

3.08 DEFERRED TESTING

- A. Refer to Section 01810, Part 3 for requirements of deferred testing.

3.09 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the start-up and initial checkout plan described in Section 01810 and the filled out start-up, initial checkout and prefunctional checklists.

PART 4 – PRE-FUNCTIONAL AND FUNCTIONAL CHECKLISTS

4.01 PRE-FUNCTIONAL TEST DESCRIPTION

- A. This section contains representative Pre-functional checklists (PC) in a form format. Actual Pre-functional Checklists will be provided at a later date.
 1. The checklists contain items for both Mechanical and Electrical contractors to perform. On each checklist, a column is provided that should be filled out by the contractor assigning responsibility for that item to a trade.

2. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.

3. Refer to Section 01810 for additional requirements regarding pre-functional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. Any forms used for documenting the PCs will be in addition to the PC forms provided by the CA. Contractors assigned responsibility for sections of the checklist shall be responsible to see that the checklist items by their subcontractors are completed and checked off. "Contr." column or abbreviation in brackets to the right of an item refers to the contractor

responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

4.02 PREFUNCTIONAL AND FUNCTIONAL CHECKLISTS

A. Sample checklist forms follows:

Prefunctional Checklist – Exhaust Fans ID

Project _____

1. Submittal / Approvals:

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. List attached.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Sheet Metal Contractor	Date
_____	_____	_____	_____
TAB Contractor	Date	General Contractor	Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer’s recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- “Contr.” column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, _____ = _____.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner’s Representative	Date

2. Requested Documentation Submitted:

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Manufacturer's cut sheets							
Performance data (fan curves, coil data, etc.)							
Installation and startup manual and plan							
Sequences and control strategies							
O&M manuals							

- *Documentation complete as per contract documents for given trade* ___ YES ___ NO

3. Model Verification:

1 = as specified, 2 = as submitted, 3 = as installed.

Check if Okay. Enter note number if deficient.

Equip Tag-->					
Manuf.	1				
	2				
	3				
Model	1				
	2				
	3				
Serial #	3				
CFM	1				
	2				
	3				
Sound Pwr					
Level @ 63,					
250; 1K Hz					

- *The equipment installed matches the specifications for given trade* ___ YES ___ NO

4. Installation Checks:

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->							Contr.
Cabinet and General Installation								
Permanent labels affixed								
Casing condition good: no dents, leaks, door gaskets installed								
Mountings checked and shipping bolts removed								
Vibration isolators installed								
Equipment guards installed								
Pulleys aligned								
Belt tension correct								
Plenums clear of debris								
Fans rotate freely								
Fire and balance dampers installed								
Backdraft dampers installed, per drawings, and operate freely								
Duct system complete								
Electrical								
Electrical connections complete								
Disconnect switch installed								
Overload heaters in place								
Control connections complete								
Operational Checks								
Fan rotation correct								
Electrical interlocks verified								
Any fan status indicators functioning								
No unusual vibration or and noise								
Record full load running amps for each fan. _____rated FL amps x _____svc factor = _____ (Max amps). Running less than max?								
Check voltage: Rate = _____ Actual = _____ Within 5%?								
The disconnect switch properly operates								
After 24 hours of operation, recheck belt tension and alignment								

- **The checklist items of Part 4 are all successfully completed for given trade ___YES ___NO**

-- END OF CHECKLIST--

END OF SECTION

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SECTION 01812

ELECTRICAL EQUIPMENT COMMISSIONING

PART 1 - GENERAL

1.01 RELATED WORK

- A. Drawings and general provisions of the contract shall apply to work in this section.
- B. 01810 Building Commissioning.
- C. 01811 Mechanical System Commissioning.

1.02 SUMMARY OF WORK

- A. The Electrical Commissioning shall include the Testing and Certification of; the general electrical equipment installation, and the installed Lighting System Design and associated controls.

1.03 WORK NOT INCLUDED

- A. The following systems are not included in the Electrical Commissioning work:
 - 1. Fire Alarm System
 - 2. Public Address/Background Music System
 - 3. Telephone System
 - 4. Computer Network System
 - 5. Security System
 - 6. CCTV System
- B. The entity responsible for certifying these systems is shown in parenthesis. While the commissioning of these systems is not included in this work scope, these systems (particularly Fire Alarm and Telephone) will need to be installed and operational to complete certain portions of this work where interfaces with these systems is required to verify the system operational requirements of the Lighting System.

1.04 SUBMITTALS

- A. Provide submittal documentation relative to commissioning as described in Section 01810.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Refer to Section 01810 PART 2.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Refer to Section 01810 and related sections for information on meetings, start-up plans, functional testing, operations & maintenance data, training requirements, and other Commissioning activities.

3.02 TESTING REQUIREMENTS

- A. The commissioning authority will prepare testing procedures using the Design Intent Document, the testing requirements listed in these specifications, and commissioning data submitted by the contractors in accordance with these specifications. The testing procedures will require the following minimum information:
 1. Test number.
 2. Date and time of the test.
 3. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 4. Identification of the system, subsystem, assembly, or equipment.
 5. Conditions, under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.
 6. Expected performance of the systems and assemblies at each step of the test.
 7. Narrative description of observed performance of the system, equipment, or assembly.
 8. Notation to indicate whether the observed performance at each step meets the expected results.
 9. Issue number, if any, generated as the result of the test.

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10. Dated signatures of the person performing the test and of the witness.
- B. General Electrical Equipment Installation: The following electrical equipment and systems shall be tested and calibrated:
1. Conductors.
 2. Wiring Devices.
 3. Panel boards.
 4. Transformers.
 5. Low Voltage Front Accessible Main Switchboard.
 6. Motor Control.
 7. Underground Electrical Site Distribution.
 8. Grounding System.
- C. Lighting System and Controls Testing Requirements. This is a performance test to verify lighting system operation, light levels, and energy usage.
1. Electrical subcontractor to start-up and to document lighting system and controls under the observation of the CA using a start-up plan prepared by the contractor. Start-up Plans are described in Section 01810.
 2. Electrical subcontractor to perform functional testing under the observation of the commissioning authority who will record the results of the functional test procedures.
 3. Equipment & Components to be tested: Lighting System and Controls.
 4. Functions, modes, and Testing Conditions
 - a. Occupancy sensors and timer controls for lighting
 - 1) Verify that all specified functions and features are set up, debugged and fully operable.
 - 2) Verify that occupant over-rides features function
 - 3) Verify that sensor durations are set properly
 - 4) Test the sequence of operation for all features and modes and confirm that adjustable timing matches the design specifications
 - b. Electric lighting dimming photocells and controls

c. Illumination Levels, Night Conditions:

- 1) Verify that lighting throughout the building is operating automatically
- 2) Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.
- 3) Verify that a minimum of one (1) foot-candle is maintained along the path of egress from the building to the property line upon loss of primary power.

d. Illumination Levels, Day Conditions:

- 1) Verify that lighting throughout the building is operating automatically
- 2) Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.
- 3) Verify that exterior site lighting automatically turns off one half after sunrise and turns on one half hour before sunset.
- 4) Verify that one foot-candle is maintained along the path of egress at the interior of the building.

- e. Lighting Power Density. Perform the test with all interior lighting turned on and any manual or automatic controls temporarily overridden. The lighting power shall be measured at the building's electrical panels. Measurements shall be taken at least 1 minute after all lighting in the building is on.

5. LEED's Lighting Requirements:

- a. Test all exterior lighting fixtures to verify compliance with LEEDs light pollution requirements. (No up lighting component requirement.)
- b. Test all exterior lighting fixtures to verify fixtures do not spill direct light rays onto adjacent properties. (Light cut-off requirement.)

6. Acceptance Criteria

- a. Lighting Controls: For the conditions, sequences and modes tested, the occupancy/photocell/timing controls, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
- b. Illumination Levels: Average light levels in the tested space at the workplane elevation shall not be less than 30% below nor greater than 30% above the specified light level range for the space.

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- c. Lighting Power Density: Average instantaneous lighting power density is +/- 15% of the design lighting power density. Power factors on lighting circuits are at least 0.95, or as required by lighting fixture specifications.

7. Sampling Strategy for Identical Units:

- a. Lighting Controls: Test all automatic interior lighting controls
- b. Illumination Levels: At least 50% of all space zones and rooms shall be verified to be realizing proper light levels, chosen by the Owner. If 25% of the spaces in the first sample fail the functional performance tests, test another 10% of the group (the 2nd sample). If 10% of the spaces in the 2nd sample fail, test all remaining spaces, fully at the contractor's expense.
- c. Power Density: No sampling. Test all lighting circuits.

PART 4 – PRE-FUNCTIONAL AND FUNCTIONAL CHECKLISTS

4.01 PRE-FUNCTIONAL TEST DESCRIPTION

- A. This section contains representative Pre-functional checklists (PC) in a form format. Actual Pre-functional Checklists will be provided at a later date.
 - 1. The checklists contain items for both Mechanical and Electrical contractors to perform. On each checklist, a column is provided that should be filled out by the contractor assigning responsibility for that item to a trade.
 - 2. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases.
 - 3. Refer to Section 01810 for additional requirements regarding pre-functional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. Any forms used for documenting the PCs will be in addition to the PC forms provided by the CA. Contractor's assigned responsibility for sections of the checklist shall be responsible to see that the checklist items by their subcontractors are completed and checked off. "Contr." column or abbreviation in brackets to the right of an item refers to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

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4.02 PREFUNCTIONAL AND FUNCTIONAL CHECKLISTS

A. Sample checklist forms follow:

Prefunctional Checklist - Lighting System

Project: _____

Lighting System (and Controls), _____ Entire Bldg, _____ Floor #

1. Submittals / Approvals:

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This pre-functional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. _____ List attached.

_____	_____	_____	_____
Electrical Contractor	Date	General Contractor	Date

Pre-functional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

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2. Installation Checks:

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient (attach notes).

Complete table for each room.

Check	Rooms →					Contr.
Lighting fixtures and switches						
Light switches are located per plans						
Light switches are labeled with proper ID to match drawings or field changes						
Light switch is controlling the fixtures in the area indicated on design drawings						
Fixtures are properly supported for seismic zone						
Verify proper lamp type is installed in each fixture to match fixture schedule and specifications						
Lighting controls						
Lighting control is installed per manufacturer recommendations (attached recommendations to this checklist)						
Lighting control is calibrated per manufacturer checklist						

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient (attach notes).

Complete table for each room.

Check	Rooms →					Contr.
Lighting fixtures and switches						
Light switches are located per plans						
Light switches are labeled with proper ID to match drawings or field changes						
Light switch is controlling the fixtures in the area indicated on design drawings						
Fixtures are properly supported for seismic zone						
Verify proper lamp type is installed in each fixture to match fixture schedule and specifications						
Lighting controls						
Lighting control is installed per manufacturer recommendations (attached recommendations to this checklist)						
Lighting control is calibrated per manufacturer checklist						

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient (attach notes).

Complete table for each room.

Check	Rooms →					Contr.
Lighting fixtures and switches						
Light switches are located per plans						
Light switches are labeled with proper ID to match drawings or field changes						

Complete table for each room.

Check	Rooms →					Contr.
Light switch is controlling the fixtures in the area indicated on design drawings						
Fixtures are properly supported for seismic zone						
Verify proper lamp type is installed in each fixture to match fixture schedule and specifications						
Lighting controls						
Lighting control is installed per manufacturer recommendations (attached recommendations to this checklist)						
Lighting control is calibrated per manufacturer checklist						

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient (attach notes).

Complete table for each room.

Check	Rooms →					Contr.
Lighting fixtures and switches						
Light switches are located per plans						
Light switches are labeled with proper ID to match drawings or field changes						
Light switch is controlling the fixtures in the area indicated on design drawings						
Fixtures are properly supported for seismic zone						
Verify proper lamp type is installed in each fixture to match fixture schedule and specifications						
Lighting controls						
Lighting control is installed per manufacturer recommendations (attached recommendations to this checklist)						
Lighting control is calibrated per manufacturer checklist						

Checklist items of Part 2 are all successfully completed for given trade ___ Yes ___ No

-- END OF CHECKLIST --

END OF SECTION

**DIVISION 2
SITEWORK**

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SECTION 02110

SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all site clearing, tree protection, and demolition as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

B. Related work specified elsewhere:

1. Removal or abandonment of mechanical or electrical underground piping or conduit, except storm sewers: Divisions 15 and 16.

1.02 QUALITY ASSURANCE

- A. Perform work in accord with OSHA and EPA requirements and state and local requirements.
- B. Comply with Rancho Mirage and SCAQMD PM10 Regulations.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 PROTECTION

- A. Provide barricades, coverings, and other protection necessary to prevent damage to existing improvements to remain.
 1. Protect improvements on adjoining properties as well as those on Owner's property.
 2. Restore any improvements damaged by this work to original condition, as acceptable to Owner or other parties or authorities having jurisdiction.
- B. Protect existing trees and other vegetation to remain against damage.

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1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
3. Provide temporary protection as required.

3.02 SITE CLEARING - GENERAL

- A. Owner shall remove all trees and/ or shrubs the Owner desires to have salvaged and transplanted. The Owner shall be responsible for this work as designated on the Landscape Demolition Plan. All other trees and shrubs shall be removed by the Contractor including stumps and roots.
- B. Remove other items when specifically indicated.
- C. Follow regulations and directives per PM 10 drawings.

3.03 REMOVAL OF IMPROVEMENTS

- A. Remove surfacing and pavements, including bases, concrete slabs, concrete curb and gutter, valve boxes, concrete and masonry walls, posts, poles and other items indicated.
- B. Remove foundations, footings, walls and other items indicated.
- C. Remove underground storm drainage piping which interferes with construction.

3.04 DISPOSAL OF WASTE MATERIALS

- A. Do not burn combustible materials on site.
- B. Remove all waste materials from site.
- C. Do not bury organic matter on site.
- D. Remove all rock, concrete and masonry from site.

END OF SECTION

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SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for earthwork, excavating, and backfilling as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Permits and Ordinances:

1. Produce and pay for all necessary permits or certificates required by local authorities having jurisdiction over the work.

C. All excavation is unclassified.

D. Related work specified elsewhere:

1. Section 02260 - Finish Grading
2. Section 02513 – Asphaltic Concrete Paving
3. Section 02520 – Concrete Paving and Curbs
4. Section 02632 – Trench Grates and Frames
5. Section 02720 – Storm Drainage System

E. Definitions:

1. Unclassified excavation: Excavate and grade all materials that can be removed without blasting or drilling.

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2. Engineer: Soils Engineer employed by Owner, empowered to conduct inspections and make approvals.
3. Soils Report: Report No. LP06084 prepared by Landmark dated April, 27 2006 and located in Section 00220 – Geotechnical Data.

1.02 QUALITY ASSURANCE

- A. Perform work in accord with CAL-OSHA requirements and State and Local requirements.
- B. Compaction density test: Modified Proctor ASTM D1557-78.
 1. Layout work shall be performed by a licensed surveyor or civil engineer registered in State of California.
 2. Maintain all bench marks, control monuments or stakes, whether newly established by Surveyor or previously existing. Protect from damage and discoloration. If necessary to disturb existing bench marks, re-establish in a safe place.
 3. If any discrepancies are found by Surveyor between the Drawings and actual conditions at the Site, Architect reserves the right to make such minor adjustments in work specified as necessary to accomplish the intent of the Contract Documents, without increased cost to the Owner.
- C. Owner will hire and pay for an independent geotechnical laboratory to conduct in-place moisture and density tests.
 1. Geotechnical Engineer:
 - a. Landmark Geotechnical Engineers and Geologists – (760) 360-0665 (See Section 01400 – General Testing Procedures.)
 2. Initial tests shall be paid by the Owner. If initial test fails, further re-testing shall be paid by the Contractor.
 3. Soil Testing Laboratory shall provide copies of soil compaction testing to Architect, Contractor, Owner, and City of Palm Springs.
 4. A satisfactory number of compaction tests shall be conducted in all foundation areas to insure the compaction requirements covered in paragraphs 3.02 of this section.
- D. Tolerances of sub-grade:
 1. Unsurfaced areas: 0.20 Ft. plus/minus from required elevations.

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2. Paved areas: 0.10 Ft. plus/minus from required elevations.

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1.03 JOB CONDITIONS

- A. Protect existing facilities, utilities, (overhead and underground), sidewalks, and pavement.
 - 1. Repair damaged items. Notify the Architect immediately of any unforeseen utilities and make emergency repairs as necessary.
 - 2. Where existing utilities not shown on the Drawings are encountered, support, shore-up, protect same and immediately notify Architect. Allow entrance, opportunity and ample time for measures necessary for continuance and/or relocation of such services. Cost of repair to items not indicated on plans shall be paid for by the Owner.
 - 3. Where noted on Drawings, cut and cap all street connections encountered in excavating along curb line and mark location so they can subsequently be located and reconnected as required.
- B. Protect graded areas against erosion.
 - 1. Keep all excavations, pits, trenches, footings, etc., entirely free from water.
 - 2. Re-establish grade where settlement or washing occurs at no extra cost.
- C. The Contractor shall be responsible for providing an effective means of PM10 dust control, which shall include provisions or adequate watering during the grading process and provisions for continuance of dust control after the grading, until such time that the graded surface presents efficient protective cover against wind or water erosion, and that special dust control measures are no longer necessary.

1.04 SUBMITTALS (SEE SECTION 01340)

- A. Pad Certification by licensed Surveyor. Submit Certification letter to Architect, Contractor, and City of Palm Desert.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Fill and backfill materials:
 - 1. Clean soil similar to on-site soil or non-expansive soil, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM and free of roots, organic material, trash, and stones larger than 3". The geotechnical engineer shall approve all imported fill soil sources before hauling material to the site. Imported granular fill shall be placed in lifts of

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no greater than 8 inches in loose thickness and compacted to a minimum of 90% of ASTM D1557 maximum dry density at least 2% above optimum moisture.

2. Add water to dry material, as required.
3. Allow wet material to dry, as required.
4. Provide additional borrow or fill as required, at no extra cost.
 - a. Provide non-expansive material with plasticity Index less than 35, maximum 1" particle size, and approved by Soils Engineer.
5. No borrow or fill can be obtained on site, except as removed from excavating and grading, and only non-expansive type soils.

B. Surplus material:

1. Remove hard debris, such as concrete and stone, from site.
2. Clean fill material of the non-expansive type may be disposed of on-site in location designated by Soils Engineer.
3. Remove from the site and legally dispose of all debris and excavated material not required for fill. No rubbish or debris shall be buried on the site.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Layout structures, water features, parking area, walks and establish their elevations.
- B. Perform all other layout work required.
- C. Replace property or building corner markers to original location if disturbed or destroyed.
- D. All areas to be graded should be stripped of significant vegetation, and other deleterious materials. Root balls shall be completely excavated and removed from the site. Organic strippings shall be hauled from the site and not used as fill. Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations and utility lines exposed during excavation should be traced to the limits of the foreign material by the grading contractor and removed under the supervision of the geotechnical engineer. Any excavations resulting from site clearing shall be dish-shaped to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer.

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- E. The cavities created by the removal of vegetation, exploratory trenches utilized for soils investigation, removal of pole foundations or other subsurface obstructions, if encountered, should be thoroughly cleaned of loose soil, organic matter and other deleterious materials, shaped to provide access for construction equipment, and backfilled as recommended for site fill.

3.02 GENERAL

- A. Preparation of Fill Areas:

Prior to placing fill, the surfaces of all areas to receive fill should be scarified to a depth of 12" or more. The scarified soils should be brought to near optimum moisture content and recompacted to a minimum relative compaction of 90 percent in accordance with ASTM D 1557-91.

- B. Preparation of Building Pad and Footing Areas:

All footings should rest upon at least 18" of properly compacted fill material or should be embedded at least 18" into approved original ground soils. The existing surface soil within the building pad area shall be sub excavated to a depth of 36" below the existing grade or 18" below the lowest foundation level (whichever is lowest) extending five feet beyond all exterior wall/column lines (including adjacent concreted areas). Exposed sub grade shall be scarified to a depth of 8"; uniformly moisture conditioned to at least 2% above optimum moisture content, and re-compacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

Footings should not be allowed to span from native to fill soil conditions. If a native to fill soil condition should exist, footing areas shall be subexcavated and recompacted as described above so as to provide a compacted fill mat for support. If footings are to be placed entirely in suitable native soils, the footing excavations should be observed by the soils engineer prior to forming and utility installation.

- C. All surfaces to receive fill which are not under foundations should be scarified to a depth of at least 12". The scarified soils shall be spread in 8" or less lifts with each lift moistened to a near optimum moisture content and compacted to a relative compaction of at least 90 percent (ASTM D-1557-70).
- D. The on-site soils should provide adequate quality fill materials provided they are free from organic matter and other deleterious materials. The native soils shall be placed in maximum 8 inch lifts (loose) and compacted to a minimum of 90% of ASTM D1557 maximum dry density at least 2% above optimum moisture. Unless approved by the Soils Engineer, rock or similar irreducible material with a maximum dimension greater than 3" shall not be buried or placed in fills.

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Based upon the relative compaction of the native soils determined during this investigation and the relative compaction anticipated for compacted fill soils, it is estimated a compaction shrinkage of approximately 5 to 10 percent will occur. Therefore, 1.05 cubic yards to 1.10 cubic yards of in-place soil material would be necessary to yield one cubic yard of properly compacted fill material. In addition, it is anticipated there will be subsidence of approximately 0.1'. These values are exclusive of losses due to stripping, tree removal or the removal of other subsurface obstructions, if encountered, and may vary due to differing conditions within the project boundaries and the limitations of the soils investigation.

Values presented for shrinkage and subsidence are estimates only. Final grades should be adjusted, and/or contingency plans to import or export material should be made to accommodate possible variations in actual quantities during site grading.

- F. Cut and fill slopes, should be constructed no steeper than 2 horizontal to 1 vertical. Fill slopes, should be overfilled during construction and then cut back to expose.
- G. Backfill any excess excavation under footings with concrete at Contractor's expense.
- H. Shore and brace excavations where necessary to prevent cave-ins, and in accordance with all safety laws and codes.
- I. Backfill soil within roadways shall be placed in layers not more than 6 inches in thickness and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density except for the top 12 inches of the backfill shall be compacted to 95%. Native backfill shall only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material. Pipe envelope/bedding material should either be clean sand (Sand Equivalent SE > 30) or crushed rock when encountering ground water. A geotextile filter fabric (Mirafi 140N or equivalent) shall be used to encapsulate the crushed rock to reduce the potential for in-washing of fines into the gravel void space. Precautions should be taken in the compaction of the backfill to avoid damage to pipes and structures.
- J. Control grading around building:
 - 1. Pitch earth to prevent water from running into excavated areas or damaging structure.
 - 2. Maintain all pits and trenches, where footings will be placed, free of water at all times.
 - 3. Provide all pumping required to keep excavated spaces clear of water during construction.

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4. When springs or running water are encountered, notify Soils Engineer, provide free discharge of water by trenches or pumps, and drain to appropriate point of disposal as directed.

K. Pre-job Conference:

It is imperative that no clearing and/or grading operations be performed without the presence of a representative of the soils engineer. An on-site pre-job meeting with the architect, the contractor and the soils engineer shall occur prior to all grading related operations. It should be stressed that operations undertaken at the site without the presence of the soils engineer may result in exclusions of affected areas from the final compaction report for the project.

L. Construction Observation:

All grading operations, including site clearing and stripping, shall be continuously observed by a representative of the soils engineer. The presence of the soils engineer's field representative will be for the purpose of providing observation and field testing, and will not include any supervising or directing of the actual work of the contractor, his employees or agents. Neither the presence of the soils engineer's field representative nor the observations and testing by the soils engineer shall excuse the contractor in any way for defects discovered in his work. It is understood that the soils engineer will not be responsible for job or site safety on this project which will be the sole responsibility of the contractor.

3.03 SETTLEMENT

- A. Any settlement in backfill or fill, which occurs during the warranty period and attributed to construction procedures, such as improper removal of shoring or insufficient compaction shall be corrected by Contractor at his own expense. Any structures, paved areas, piping or other facilities damaged by such settlement shall be restored to their condition prior to settlement by Contractor at his own expense.

3.04 LAYOUT FOR FINISH GRADING (SEE SECTION 02260)

- A. Perform all finish grading required, as indicted or reasonably inferred to permit installation of work of others as shown on Drawings. At completion of work entire site shall be left in a clean and finished condition conforming to plans and specifications.

3.05 EXCAVATION ADJACENT TO EXISTING STRUCTURES

- A. Since ordinary mass removal and recompaction of the soils adjacent to the existing structures, sidewalks, and masonry walls may result in unacceptable distress by the removal of bearing and lateral support, the following precautionary measures should be utilized during proposed

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subexcavation/recompaction operations to minimize the potential for distress to the existing adjacent structures.

1. During compacted fill mat construction for the proposed building addition, the excavation and replacement of soils adjacent to the existing structures should be accomplished in the shortest period of time possible. Sufficient forces and equipment should be available to accomplish any removal and replacement of soils adjacent to the existing structure within one eight-hour working day. The excavation should not be performed during periods of rain or threat of rain. During the excavation operation, the moisture content of the soils near the existing structure should be monitored. If excessive moisture contents or excessively dry soils are encountered, the soils engineer should be notified immediately.
2. The actual excavation and recompaction of soils near the existing structures should be monitored by the soils engineer and the soils engineer shall make a recommendation for an excavation method to be used. As a minimum procedure, the excavation shall be performed in alternating sections. A checkerboard type system should be utilized by initially removing and re-compacting every other square and thereupon going back and removing and re-compacting the remaining square. The width of these excavations is usually equal to the blade size of the available equipment but should not exceed 12', and in any case, should not leave greater than 1/3 of the wall being subexcavated unsupported.
3. As a further precaution, the elevation of the existing structures shall be noted and monitored continuously by the contractor during the excavation operation adjacent to the existing structure. If an elevation change is noted, excavation should be suspended and the soils engineer notified at once. In addition, if significant caving occurs under existing adjacent footings, excavation should be suspended and the soils engineer notified at once.
4. Extreme caution should be exercised during the subexcavation process near the existing structures. Vibratory type compaction equipment should not be utilized. It should be emphasized that coordination between the contractor and the soils engineer will be most important during this phase of the operation.

END OF SECTION

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SECTION 02260

FINISH GRADING

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all finished grading, as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Related work specified elsewhere:

1. Earthwork: Section 02200

C. Location of work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.02 QUALITY ASSURANCE

- A. Finish grading tolerance: 0.1-ft. plus/minus from required elevations.
- B. Comply with SCAQMD and Rancho Mirage PM10 regulations.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 ROUGH GRADE REVIEW

- A. Rough grading reviewed by Architect in Section 02200 - Earthwork.

3.02 FINISHED GRADING

- A. Correct, adjust and/or repair rough graded areas.
 1. Cut off mounds and ridges.

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2. Fill gullies and depressions.
 3. Perform other necessary repairs.
 4. Bring all grades to specified elevations and contours, even and properly compacted.
 5. Set finished grade down to allow for addition of D.G. or cobble for Section 02990.
- B. Make finished surface free of stones, sticks, or other material 1" or more in any dimension.
- C. Make finished surface smooth and true to required grades.

3.03 ACCEPTANCE

- A. Upon completion of finish grading obtain Architect's acceptance of grade and surface.

END OF SECTION

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SECTION 02280

SOIL TREATMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for soil treatment as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

1.02 QUALITY ASSURANCE

- A. Perform work in accord with CAL-OSHA requirements and State and Local requirements.

1.03 JOB CONDITIONS

- A. Protect existing facilities, utilities, (overhead and underground), sidewalks, and pavement.
1. Repair damaged items.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Soil poisoning:

1. Soil shall be treated against subterranean termites and ants by a reliable and established, licensed termite control firm thoroughly familiar with local soils and chemicals.
2. Apply an aqueous solution of TERMIDOR SC, manufactured by BASF The Chemical Co. To prepare a .06% desired finished dilution of Termidor SC, add 78 fluid oz. of Termidor SC to 99.25 gallons of water

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and mix thoroughly. Apply in accordance with the manufacturer's directions on the label as follows:

- a. Slab on-ground construction
 - (1) After all grading is completed and prior to the pouring of the slab, slab porches and entrance platforms, make the following treatments.
 - (a) Along both sides of foundation walls, interior foundation walls, around plumbing, piers and conduits, dig a narrow trench, not wider than 6 inches, or rod to a depth of 18", but not below the bottom of the footing. Apply 4 gallons of .06% solution per 10 linear feet per foot of depth of trench. Mix the emulsion with the soil as it is being returned to the trench. Treated soil should be returned to the trench. Treated soil should be covered with a thin layer of untreated soil.
 - (b) Spray 1 gallon of .06% solution per 10 square feet of earth fill that will be beneath slabs.
 - (2) Treat all voids in hollow masonry units of the foundation at the rate of 2 gallons of .06% solution per 10 linear feet. Overlap the deposition patterns so as to make a continuous chemical barrier in the voids, and apply the emulsions so it will reach the footing.
3. Guarantee - Treatment shall remain effective for not less than 5 years. The Termite Control Firm shall furnish a written 5-year guarantee in 3 copies stating that if at any time during the 5-year period, ground nesting occurs; treatment will be applied to exterminate all infestation without cost to the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

- A. All areas to be beneath slabs on grade shall be stripped of any deleterious materials. These materials should be removed from the site for disposal.

3.02 APPLICATION OF SOIL POISONING

- A. Per manufacturer's specifications.

END OF SECTION

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SECTION 02513

ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work included: Provide base course asphaltic concrete paving, weed killer, and sealer where shown on the drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Work:
 - 1. Documents affecting this Section include, but are not necessarily limited to General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
 - 2. Section 02222, Building Excavation, Filling and Backfilling.

1.02 QUALITY ASSURANCE

- A. Use adequate number of skilled workman who are thoroughly trained and experienced in the necessary craft and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

1.03 STANDARDS

- A. References herein to State Standard Specifications are to the Standard Specifications of the Department of Transportation, State of California (Caltrans), latest Edition.
- B. References herein to Standard Specifications are to the Standard Specifications for Public Work Construction, prepared by the Southern California Chapters of the American Public Works Association and The Associated General Contractors of America, 1985 Edition.

1.04 GUARANTEE

- A. Submit one year guarantee in accordance with and in form required in Division 1. Guarantee shall include bringing to grade and repairing of defective surfacing due to grade settlement of fills, trench fills, or any portion of base or surfacing.

PART 2 - PRODUCTS

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2.01 PAVEMENT SYSTEM

- A. Pad under relocatable units :
 - 1. Native subgrade: 90% compaction
 - 2. Base: 2-1/2"; 95% compaction
 - 3. Asphaltic Concrete: 3 inches
 - 4. Sealer: Fog Seal

2.02 AGGREGATES

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable, mineral materials processed and blended, and naturally combined.
- B. Base aggregate: State Standard Specifications, Section 26, Class 2, maximum size:
 - 1. Base courses over 6 inches: 1-1/2 inch.
 - 2. Other base courses: 3/4 inch.
 - 3. The aggregate base shall also have a sand equivalent value of not less than 30 when tested in conformance with Test Method No. California 217.
- C. Aggregates for asphaltic concrete paving: Standard Specifications Section 203-6, Type I - Class C (1/2") for 1-1/2" lifts. Aggregate shall be Type I - Class D (3/8") for 1" lifts.

2.03 ASPHALTS

- A. Asphalt concrete pavement shall comply with Section 203-6 and 302-5 of the Standard Specifications, except that asphalt concrete shall not be placed when the atmospheric temperature is below 50 degrees F. Paving asphalt shall be AR 4000.
- B. Comply with provisions of Standard Specifications, Section 302-5.
 - 1. Asphalt cement: Penetration grade 50/60.
 - 2. Prime Coat: SC-70 Liquid Asphalt.
 - 3. Tack Coat: Uniformly emulsified, grade SS-1H.

2.04 MIXING ASPHALTIC CONCRETE MATERIALS

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- A. Provide hot plant mixed asphaltic concrete paving materials in accordance with Standard Specifications, Section 203-6.
 - 1. Temperature leaving the plant: 290 degrees F. minimum, 320 degrees F maximum.
 - 2. Temperature at time of placing: 280 degrees F minimum.

2.05 WEED KILLERS

- A. Provide a dry, free-flowing, dust-free chemical compound containing not less than 30% sodium chlorate or a chlorateborate compound, non-flammable, not creating a fire hazard when applied in accordance with the manufacturer's recommendations, soluble in water, and capable of being spread dry or in solution.
- B. Acceptable products:
 - 1. "Spike 80W": California Weed Control Industrial Co., Upland, CA.
 - 2. Acceptable substitution products of other manufacturers when accepted in advance by the Architect.

2.06 HEADERS AND STAKES

- A. Provide Redwood, Construction grade, in dimensions shown on the Drawings or as required for the use where dimensions are not shown on the Drawings.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FINAL PREPARATION OF SUBGRADES

- A. After preparation of subgrade as specified in another Section of these Specifications, thoroughly scarify and sprinkle the entire area to be paved, and then compact to a smooth, hard, even surface of 90% compaction to receive the base aggregates or 95% to receive the asphaltic concrete.
- B. Apply the specified weed killer to the entire area to be paved. Adhere to the manufacturer's application recommendations.

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3.03 PLACEMENT OF BASE COURSE

- A. Base:
 - 1. The aggregate base material shall be spread as specified in Section 26-1.035 and 26-1.04 of the State Standard Specifications. The aggregate base material shall be compacted as specified in Section 26-1.05 of the State Standard Specifications.
 - 2. Spread the specified base material to a thickness providing 2-1/2 inch minimum thickness unless otherwise noted.
 - 3. Compact to 95%.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0" to plus 0.5".
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 3/8" in ten feet.
 - 1. Deviations: Correct by removing materials, replacing with new materials, and reworking or recompacting as required.
- D. Moisture content: use only the amount of moisture needed to achieve the specified compaction.

3.04 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. The method of depositing, distribution and rolling the asphalt concrete shall be in accordance with Sections 302-5.4 and 302-5.5 of the State Standard Specifications.
- B. Install the specified headers and stakes to achieve the arrangement of paving shown on the Drawings.
- C. Remove all loose materials from the compacted base.
- D. Apply the specified prime coat, and tack coat where required, Standard specification, Sections 302-5.2 and 302-5.3, and allow to dry.
- E. Adjust frames and covers, if so required, to meet final grades.
- F. Receipt of asphaltic concrete materials:
 - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 280 degrees F.

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2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 50 degrees F. nor during fog, rain, or other unsuitable conditions.

G. Spreading:

1. Spread material in a manner which required the least handling.

H. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the Drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. Free from birdbaths.
 - b. No deviations greater than 1/8" in six feet.

3.05 FLOOD TEST

- A. Prior to application of seal coat, perform a flood test in the presence of the Architect.
- B. Method:
 1. Flood the entire asphaltic concrete paved area with water by use of a tank truck or hoses.
 2. If a depression is found where water ponds to a depth of more than 1/8" in six feet, fill or otherwise correct to provide proper drainage.
 3. Feather and smooth the edges of fill so that the joint between fill and original surface is invisible.

3.06 APPLICATION OF SEAL COAT

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with State Standard Specifications, Section 302-4.
- B. Apply one coat of the specified sealer.

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- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.07 PROTECTION

- A. Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

END OF SECTION

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SECTION 02518

SOLID CONCRETE INTERLOCKING PAVERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and place sand laying course.
- B. Furnish and install interlocking concrete pavers in the quality, shape, thickness and color as specified.
- C. Furnish and install all accessory items as required by the Contract.

1.02 RELATED WORK

- A. Preparation of sub-base - see Section 02200.
- B. Furnish and install base course materials - see Section 02520.
 - 1. Provide an aggregate sub base of a minimum of 4" in accordance with paragraph 5.9 of the Soils Report in Section 00220.

1.03 REFERENCES

- A. ASTM C936 - "Standard Specification for SOLID CONCRETE INTERLOCKING PAVING UNITS".
- B. NCMA-TEK, TEK 87 - "Construction of Concrete Masonry Pavement".

1.04 SUBMITTALS

- A. Manufacturer's product data.
- B. Documentation of installer's experience.
- C. Manufacturer's installation instructions.
- D. Six pavers of each color.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacturing of solid concrete interlocking pavers for a period of 5 years. Single layer production only, multi layer production is unacceptable.

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1.06 MOCK-UPS

- A. Provide mock-up of pavers under the provisions of Section 01340.
- B. Size of mock-up shall be determined based on extent of pattern to be adequately shown.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver pavers in such a manner that no damage occurs during shipping, handling, unloading, and storage.

1.08 PROJECT CONDITIONS

- A. Install pavers only under conditions stipulated in manufacturer's instructions.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate installation of pavers with work scheduled in Section 01310.

1.10 WARRANTY

- A. Installation:
 - 1. Installer shall provide a one (1) year written guarantee.
- B. Pavers:
 - 1. Manufacturer shall provide a one (1) year written guarantee.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Orco Block Co., Banning, CA.
 - 1. Style: Del Mar.
 - 2. Thickness: 2-3/8" (60 mm).
 - 3. Color: Chateau (B9) color blend.

2.02 MATERIALS

- A. Pavers:
 - 1. Cementitious Materials:

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- a. Portland Cements shall conform to ASTM Specification C-150.
 2. Aggregates:
 - a. Aggregates shall conform to ASTM Specification C-33 for Normal Weight Concrete Aggregate (no expanded shale or lightweight aggregates) except that grading requirements shall not necessarily apply.
 3. Other Materials:
 - a. Coloring pigments, air entraining agents, integral water repellents, finely ground silica, etc., shall conform to ASTM standards where applicable, or shall be previously established as suitable for use in concrete.
- B. Sand Laying Course:
1. The sand laying course shall be well-graded, clean, washed sand with 100% passing a 3/8" sieve size and a maximum of 3% passing a No. 200 sieve size.
 2. Use concrete sand, limestone screening, or similar. Do not use mason sand.
 3. The sand laying course is the responsibility of the paving stone installer.
- C. Edge Restraint:
1. All edges of the installed pavers shall be restrained. The type of edge restraint shall be approved at locations and per details noted on plans.
 2. Edge restraint shall be:
 - a. Concrete curb or sidewalk (cast-in-place).
 - b. Other suitable methods of preventing movement of edge pavers.

2.03 PHYSICAL REQUIREMENTS

- A. Compressive Strength:
1. At the time of delivery to the work site, the average compressive strength shall not be less than 8,000 psi with no individual unit strength less than 7,200 psi, with testing procedures in accordance with ASTM Standard C-140.
- B. Absorption:

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1. The average absorption shall not be greater than 5% with no individual unit absorption greater than 7%.
- C. Proven Field Performance:
 1. Satisfying field performance is indicated when paving units similar in composition, and made with the same manufacturing equipment as those to be supplied to the Owner, do not exhibit excessive deterioration after at least one (1) year.

2.04 VISUAL INSPECTION

- A. All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or permanence of the construction.
- B. Minor cracks incidental to the usual methods of manufacture, or chipping resulting from customary methods of handling in shipment and delivery, may be deemed grounds for rejection.

2.05 SAMPLING

- A. The Owner or his authorized representative shall be accorded proper facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.

2.06 REJECTION:

- A. In the event the shipment fails to conform to the specified requirements, the manufacturer may sort it, and new test units shall be selected at random by the Owner from the retained lot and tested at the expense of the manufacturer. If the second set of test units fails to conform to the specified requirements, the entire lot shall be rejected.

2.07 EXPENSE OF TESTS

- A. The expense of inspection and testing shall be borne by the Owner unless otherwise agreed.

PART 3 - EXECUTION

3.01 PREPARATION

- A. A minimum aggregate base of 4" shall be prepared as specified in related sections of this specification. (See Section 00220 paragraph 5.9)

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- B. The base course shall be shaped to grade and cross section with an allowable tolerance of 1/4" (5mm) (relative to specified dimensions below finish design elevation).
- C. The top of the compacted base shall be 3-3/8" (86mm) below final grade for 2-3/8" (6cm) pavers.

3.02 SAND LAYING COURSE

- A. Contractor shall inspect and approve the finished base course prior to placement of the sand laying course.
- B. Spread the sand evenly over the area to be paved.
- C. Screed the sand to a level that will produce a 1" (25mm) thickness when the paving stones have been placed and vibrated.
- D. In addition, provide the proper level of sand such that the final elevation of paving stones will be nominally 1/4" to 3/8" higher than the adjacent curb, gutters, other paving, etc., to allow for free drainage from chamfers on block edges.
- E. Do not disturb this sand laying course once screeding and leveling to the desired elevation is achieved.

3.03 PLACEMENT

- A. The pavers shall be placed in the approved pattern as noted or shown on the drawings.
- B. The pavers shall be placed in such a manner that the desired pattern is maintained and the joints between the pavers are nominally 1/8" with no individual gap exceeding 1/4".
- C. Use string lines to hold all patterns true.
- D. The gaps at the edge of the paver surface shall be filled with standard pavers or with pavers cut to fit.
- E. The cutting of pavers, using a doubleheaded breaker or a masonry saw, shall leave a clean edge to the traffic surface.
- F. When cutting precision designed areas, a masonry saw shall be used.
- G. Pavers to be alternately selected from at least three (3) pallets, working from top to bottom in each pallet stack.

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- H. Pavers shall be vibrated into the sand laying course using a vibrator capable of 3,000 to 5,000 pounds compaction force with the surface clean and the joints open.
- I. After vibration, clean masonry type sand containing at least 30% of 1/8" (3mm) particles shall be spread over the paving stone surface, allowed to dry, and vibrated into the joints with additional vibrator passes and brushing so as to completely fill the joints.
- J. Surplus material shall be left on the surface during construction to insure complete filling of the joints during initial use. This sand may also provide surface protection from construction debris. Any surplus at completion shall be swept from the surface.
- K. Upon completion of work covered in this section, the Contractor shall clean up all work areas by removing all debris, surplus material and equipment from the site.

END OF SECTION

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SECTION 02520

CONCRETE PAVING AND CURBS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for concrete paving and curbs, as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

1.02 QUALITY ASSURANCE

- A. Construction minimum standards: "Standard Specifications for Public Works Construction", latest edition.
- B. Should conflicts arise between standard specifications of government agencies mentioned herein and Contractor Documents, Contract Documents shall govern.
- C. Where a particular type of material or method is specified, no other type of material or method will be permitted.

1.03 SUBMITTALS (SEE SECTION 01340)

A. Product data:

1. Concrete mix design. (Per Section 01400 - General Testing Procedures).

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete (air-entrained):

1. For walk paving: Class B.

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2. For curbs: Class A.
- B. Aggregate base: Class 2, in accord with Section 26 of State Specifications.
- C. Expansion joint filler: ASTM D545, flexible foam, Sonneborn "Sonoflex F" or W.R. Meadows "Ceramar", 1/2" thick.
- D. Sealant: F.S.TT-S-00227E, type 1, class A, polyurethane type: Use self-leveling type for horizontal joints and gun-grade, non-sag type for vertical joints - gray color.
- E. Moisture barrier: Visqueen, 6 mil thickness.

PART 3 - EXECUTION

3.01 CONSTRUCTION - GENERAL

- A. Construct to line and grade indicated. Construct in accord with the City of Indian Wells Standards and Standard Specification.

3.02 CONCRETE WALK PAVING

- A. On properly compacted subgrade, install continuous layer of moisture barrier, overlapping all edges minimum of 12".
- B. On properly installed moisture barrier, install 2" layer of aggregate base. Compact aggregate base to 90 percent relative compaction as determined by Test Method No. California 216. Thoroughly water after placing.
- C. On properly installed and compacted aggregate base, install 4" layer of concrete.
 1. Place all paving 1/4" above top of future curb.
 2. Slope surface at 1/4" per ft. (1:50) transversely toward future curb.
 3. Finish/Color: Wood float, non-directional, uniform with salt finish. Color to be gray.
- D. Provide weakened plane (contraction) joints where indicated.
- E. Provide expansion joints where indicated and where walks meet other structures.
 1. Expansion joints at 24 ft. on center maximum.
 2. Set joint filler to within 1/2" of surface.

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3. Do not seal transverse joints of single width walks. Seal all other joints.

3.03 CONCRETE CURBS

- A. Provide as detailed on drawings.
- B. Provide weakened plane (contraction) joints at 10 ft. on center maximum with metal templates or saw cutting.
 1. Saw cut depth to be 1/4 of curb thickness.
 2. Cut top and face of curb.
- C. Provide expansion joints, 3/4" at 100 ft. on center maximum.
- D. Do not seal joints.

END OF SECTION

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SECTION 02720

STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all storm drainage systems as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. All excavation is unclassified.

C. Definitions:

1. Engineer: Soils Engineer employed by Owner, empowered to conduct and make approvals.
2. Unclassified excavation: Excavate and grade all materials.

1.02 QUALITY ASSURANCE

- A. Storm drainage system standards: State of California, Department of Transportation, "Standard Specifications", July '84, as amended to date.
- B. Should conflicts arise between standard specifications of government agencies mentioned herein and Contract Documents, Contract Documents shall govern.
- C. Where a particular type of material or method is specified, no other type of material or method will be permitted, except as described in Section 01640, but the balance of State Specifications shall apply.
- D. Compaction density test: Modified Proctor ASTM 01557-78.

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- E. Owner will hire an independent soils laboratory to conduct in-place moisture and density tests.
 - 1. Contractor to pay for retests of material not passing initial tests.
- F. AASHTO and ASTM standards indicated.

1.03 JOB CONDITIONS

- A. Lengths indicated on drawings are for information only. Furnish lengths as required.
- B. Perform no pipe work in fill areas until embankment or fill has been completed to at least 2 ft. above top of pipe and has been properly compacted.
- C. Verification of existing utilities and structures.
 - 1. Plans indicate existing utilities as shown on site survey.
 - 2. Verify accuracy, location and depth of each utility prior to open cut trenching or tunneling.
 - 3. If pipe adjustment is necessary due to location of other utilities, secure approval from Architect/Engineer.
- D. Revisions to Contract Drawings.
 - 1. If it becomes necessary to change location of storm drainage lines due to building construction, secure approval of Architect/Engineer.
 - 2. If contractor initiated, make approved changes without added cost to Owner.
- E. Do not change pipe sizes without securing written approval of Architect/Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Acceptable manufacturers:
 - 1. All pipe and fittings: Manufacturer who has produced pipe successfully used, for at least 5 years.
- B. Vitrified clay pipe, extra strength (VCPX):
 - 1. Pipe and fittings: ASTM C700-78a.

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2. Laying length of 3, 4, or 5 ft.
 3. Actual internal diameter of vitrified clay piping not less than nominal diameter of pipe as indicated.
 4. Joints: Compression type, removable rubber gaskets, ASTM C425-77.
- C. Concrete: Class A, air entrained.
- D. Backfill material: As approved by Engineer.
1. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
 2. Moisture content at time of placement: 2 percent plus/minus of optimum moisture content, as tested in accord with ASTM D1557-78.
 - a. Add water to dry material, as required.
 - b. Allow wet material to dry, as required or furnish off-site material at no additional cost to Owner.

PART 3 - EXCAVATION

3.01 EXCAVATION, BACKFILL AND COMPACTION

- A. Excavate trenches by open cut method to depth indicated on plans and necessary to accommodate the work.
- B. Open no more than 300 LF of trench at one time, or less as required by Engineer.
- C. Keep trenches free of water.
- D. Form bell holes in trench so only barrel of pipe is firmly supported by shaped subgrade.
- E. Tamp backfill under and around pipe up to 24" above top of pipe in lifts not exceeding 8" loose thickness.
- F. Backfill and compact remainder of trench in 8" lifts to density specified.
- G. Tamp evenly on both sides of pipe to top of excavation or to a depth such that pipe will not be damaged by subsequent compaction used to achieve required density.

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- H. Exercise care in backfilling operations to avoid displacing pipe joints either horizontally or vertically and to avoid breaking pipe.
- I. Do not water flush for consolidation.
- J. Compact all trench backfill in areas under paved areas and other structures to minimum of 95 percent Modified Proctor.
- K. In locations where trench will not be under paved areas or structures, compact to minimum of 90 percent Modified Proctor.
- L. Remove materials which cannot be compacted as specified and replace with suitable material.

3.02 INSTALLATION OF PIPE

- A. Lay pipelines on uniform grades between inverts.
- B. Locate structures as indicated and construct lines between them.
- C. Lay pipe upgrade beginning at lower end.
- D. Provide proper facilities for lowering sections of pipe into trenches.
- E. Do not lay pipe in water.
- F. Do not lay pipe when trench conditions or weather is unsuitable for such work.
- G. Remove any section of pipe already placed which is found to be out of alignment, defective or damaged. Relay or replace as directed, without additional cost to the Owner.
- H. Bedding: Lay pipe directly on shaped subgrade.
 - 1. No blocking permitted.
 - 2. Form a continuous bearing with a minimum width of bearing equal to six tenths (0.6) of outside diameter of pipe, for full length of pipe, except for portion at hole excavated for joint.

3.03 DRAINAGE STRUCTURES

- A. Concrete work: Conform to applicable requirements of State Specifications. Form, size, and brace so finished structures conform to details indicated.

3.04 FIELD QUALITY CONTROL

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- A. Check each line with a light. Each line shall show a good light circle throughout its length.
- B. Test pipe, fitting and joints for leakage and infiltration.
- C. Should these tests show line to be defective, remove defective portion and replace.
- D. Retest.

END OF SECTION

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SECTION 02810

AUTOMATIC IRRIGATION SYSTEM

Conditions of the Contract and Division 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.01 SCOPE

- A. Furnish all labor, materials, supplies, tools and transportation and perform all operations for the complete installation of the irrigation system as shown on the drawings and herein specified.
- B. The work shall include but shall not necessarily be limited to the following:
 - 1. Ordering, furnishing, and installing materials for complete system including piping, valves, fittings, backflow preventor, sprinkler heads, automatic controller, and final adjustment of heads, to insure complete coverage.
 - 2. Trenching, stockpiling excavation materials and refilling trenches, including compaction of back fill and installation of sleeves.
 - 3. Line voltage connections to the irrigation controllers and low voltage control wiring from controllers to remote control valves.
 - 4. Replacement of unsatisfactory materials.
 - 5. Clean-up, inspection and approval.
 - 6. Operational tests.
 - 7. "As built" record drawings, shop drawings, warranties and guarantees.

1.02 RELATED WORK

- A. Underground site utility, electrical work, landscape planting, paving, masonry walls, plumbing, grading and drainage.

1.03 REGULATIONS, PERMITS, FEES, LICENSE AND INSURANCE

- A. Obtain and pay for all permits and pay all inspection, connections, and other fees. (Furnish acceptance certificates to Architect along with "as-built" drawings).

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- B. All work and materials shall be in full accordance with the latest rules and regulations of the National Electric Code; the Uniform Plumbing Code, published by the Western Plumbing Officials Association; and other applicable State or local laws or regulations. Nothing in these Drawings or Specifications is to be construed to permit work not conforming to these codes.
1. When the Specifications call for materials or construction of a better quality or larger size than required by the above mentioned rules and regulations, the provision of the Specifications shall take precedence over the requirements of the said rules and regulations. The Contractor shall furnish without any extra charge any additional material and labor when required by the compliance with these rules and regulations, though the work be not mentioned in these particular Specifications or shown on the Drawings.
 2. The Contractor shall erect and maintain barricades, guards, warning signs, and lights as necessary or require for the protection of the public or workmen.
 3. Any existing buildings, equipment, piping, pipe covering, sewers, sidewalks, landscaping, etc. should be located and protected prior to commencing work. Damage by the Contractor during the course of his work shall be replaced or repaired by the Contractor in a manner satisfactory to the Architect, and at the Contractor's own expense, and before the final payment is made.
 4. All work shall be performed by a C-27 California Licensed Landscape Irrigation Contractor.
 5. The Contractor shall carry all worker's compensation, public liability and property damage insurance as required by public codes and the General Contractor.
 6. Water and Work Space: Water is available at the site without cost. Make and remove all temporary lines and connections.
 7. Disruption of Services: Permission to shut off any water lines must be obtained from the Construction Supervisor, who will make the necessary arrangements. Disruption in existing systems shall be kept to a minimum.
 8. Verification of Finish Grade: Verify the correctness of all finish grades within the work areas in order to insure the proper soil coverage (as specified) of the sprinkler system pipes.

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1.04 VISIT TO THE SITE

- A. The Contractor shall visit the construction site and shall take all measurements and obtain any other information as may be necessary for a complete and conclusive bid. Existing irrigation system that can be used shall be considered on the bid.

1.05 LAYOUT OF WORK

- A. The Contractor shall stake out the irrigation system as shown on the Drawings. These areas shall be checked by the Contractor and the Architect before construction is started. Any changes, deletions or additions shall be determined at this check. No walks or paved areas shall be sprinkled. The drawings are schematic only unless specifically dimensioned. Check all drawings and make this work conform to all conditions shown thereon. Exact locations shall be determined on the job to suit the actual conditions; verify with Architect any variations. Do not scale drawings. Locations so determined are the Contractor's responsibility and changes required because of such actions shall be by the Contractor at no extra cost to the Owner. Drip irrigation laterals to be installed after plants are installed. Any pipes interfering with plant locations shall be moved at the Contractor's expense.

1.06 SUBSTITUTIONS

- A. Any substitutions shall be approved by the Architect in writing prior to installation. See Section 00440, Substitutions Prior to Bidding and Section 01640, Substitutions After Execution of Contract.

1.07 SUPERVISION AND WORKMANSHIP

- A. The Contractor, personally or through an authorized and competent representative, shall supervise the work constantly, and shall as far as possible keep the same foremen and workmen on the job from commencement to completion. The workmanship of the entire job must in every way be first class, and only experienced and competent workmen will be allowed on the job.

PART 2 - MATERIALS

2.01 MATERIALS

- A. Plastic Pipe
 - 1. Extruded from 100% virgin polyvinyl chloride (PVC). Outside diameter of plastic pipe shall be the same size as iron pipe, with plain ends. All pipe and fittings shall be in accordance with the Society of Plastic Industry Standards and National Sanitation Foundation.

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2. Pipe shall be continuously and permanently marked with the following information: Manufacturer's name, normal pipe size; PVC type, S.D.R. or pressure rating; and extrusion date.
3. Plastic pipe shall be delivered to the site in unbroken bundles, packaged in such a manner as to provide adequate protection for the pipe ends, threaded or plain.
4. Main lines (constant pressure) shall be polyvinyl chloride (PVC) 1120 - SCH. 40 IPS plastic pipe with Schedule Type 1, Grade 1 PVC weld fittings.
5. Connections between main lines and remote control valves shall be of schedule 80 PVC (threaded both ends) nipples and fittings.
6. Risers shall be as shown in the construction details, if applicable.
7. Sleeves shall be schedule 40 PVC and be two sizes larger than piping.

B. Plastic Fittings and Connections

1. Fittings shall be of polyvinyl chloride (PVC), Type 1, Schedule 40, N.S.F. and of IPS solvent welded or screwed type, Lasco, Sloane or equal (same manufacturer as of pipe).
2. Plastic to plastic joints shall be solvent-weld joints. Pipe solvent shall be Johns-Manville "Blue" solvent weld cement. (No substitutions)
3. Plastic to metal joints shall be made with male adapters. The male adapter shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Permatex Type II. (Only Schedule 80 plastic pipe may be threaded).
4. Street elbows shall be Schedule 40 Marlex, unless otherwise noted on plans.

C. Steel Pipe and Fittings

1. Steel pipe shall be Schedule 40 galvanized steel with 150 pounds galvanized malleable fittings. All pipe shall be machine wrapped with Johns-Manville "Printed Trantex" using a single wrap 20 mil thick with 1/2" overlap on straight pipe and two wraps of 10 mil tape on fittings and field joints.

D. Automatic Controller

1. Provide and install automatic irrigation controller in location shown on drawings. Final location shall be verified with Architect prior to

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installation. Provide conduit and wire and connect to 120 volt switch accessible to controller for ease of maintenance. Clock and valves shall be permanently marked and small map placed in clock.

E. Valves

1. Valves shall be globe type of size, make and catalog numbers as designed on drawings and conform to controllers. Valves shall be all brass construction (unless specified otherwise) and shall have a slow closing feature, with a manual control stem. Each valve shall be able to operate manually without electrical connection to the controller.
2. Valve boxes shall be Carson No. 910 or 1419 series or equivalent with lid marked "irrigation control valve." Install 2" above grade in ground cover area. Install clean gravel in bottom.

F. Control Wire

1. Control wire shall be UL-approved for direct burial in ground, size #14-1 minimum with maximum voltage drop of 5% between valve and controller. Common ground wire shall have white insulating jacket; control wire shall have jacket of color other than white. Splices shall be made with #2006-S Buchanon splice caps and 3M #3576 Scotchlok seal packs.

G. Backflow Preventor

1. Provide and install backflow protection unit per State and local Health Department codes. Unit shall be located in such a manner as to allow for screening by plant material. Refer to plan for schematic location. Refer to detail for further information.

H. Equipment

1. Provide all equipment called for by the Drawings, and provide to the Architect, at completion of the Maintenance period, three (3) each of all operating and servicing keys, wrenches and screw drivers required for complete maintenance and operation of all heads and valves. Include all wrenches necessary for complete disassembly of all heads and valves.
2. All equipment shall be as listed in legend, details, and specifications. Any substitutions shall be approved by Architect and Owner's Representative in writing. Any unspecified equipment shall be replaced at Landscape Contractor's expense.

I. Emitters:

1. Install emitters two inches (2") above finish grade. Any emitter left at an unacceptable height shall be re-installed at no cost to the Owner

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Schedule and coordinate placement of materials and equipment in manner to effect earlier completion of work in conformance with construction and progress schedule.
2. Protect work and materials from damage during construction and storage.
3. Handle plastic pipe carefully; especially protect it from prolonged exposure to sunlight.
4. Layout work as accurately as possible in accordance with diagrammatic drawings.
5. Where site conditions do not permit locating piping, valves and heads where shown, notify Architect immediately and determine relocation in joint conference.
6. Run pipe lines and automatic control wiring in common trenches wherever practical.

B. Excavating and Trenching

1. Excavation shall be open vertical construction ample in size to permit the pipes to be laid at the elevations intended and to permit ample space for joining. Trenches for pipe shall be cut to required grade lines, and compacted to provide an accurate grade, without noticeable settlement, and uniform bearing for the full length of the line.
2. Make trenches for pipe lines deep enough to provide minimum cover from finish grade as follows:
 - a. 24 inch minimum cover over main lines to control valves.
 - b. 24 inch minimum cover over control wires from controller to valves.
 - c. 12 inch minimum cover over RCV-controlled lines in planters to sprinklers if so indicated on plans.
3. Cap or plug openings as pipeline is assembled to prevent entrance of dirt or obstruction. Remove caps or plugs only when necessary to continue assembly.

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C. Joining of Pipe

1. The Contractor is responsible to be familiar with any and all methods of assembling, joining, and installation of the various types of pipe to be used. He will adhere in strict accordance with manufacturer's recommended guide.
2. All pipe shall be assembled free from dirt and pipe scale. Field cut ends shall be reamed only to full pipe diameter with rough edges and burrs removed. All changes in direction of pipe shall be made with fittings.
3. Reducer tees shall be used at all sprinkler risers where a pipe size changes. Bushings shall not be allowed where reducer tees may be used. PVC saddles shall not be allowed.
4. Solvent-weld Joint:
 - a. Prepare joint by first making sure the pipe end is square, then deburring the pipe end and cleaning pipe and fitting of dirt, dust and moisture.
 - b. Dry-insert pipe into fitting to check for mis-sizing. Pipe should enter fitting 1/3 to 2/3 depth of socket.
 - c. Coat the inside socket surface of the fitting and the external surface of the male end of the pipe with cement. Apply a second coat of cement to the pipe end.
 - d. Insert pipe immediately into fitting and turn 1/4 turn to distribute cement and remove air bubbles. The pipe must seat to the bottom of the socket and fitting. Check alignment properly without strain to either.
 - e. Hold joint still for approximately thirty (30) seconds and then wipe the excess cement from the pipe and fitting.
5. Threaded Joint:
 - a. Field-threading of plastic pipe or fittings is not permitted. Factory-formed threads only will be permitted.
 - b. Factory-made nipples shall be used wherever possible. Field-cut threads in metallic pipe will be permitted only where absolutely necessary. When field threading, cut threads accurately on axis with sharp dies.

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- c. All threaded joints shall be made up with pipe joint compound. Apply compound to male threads only.
- d. Where assembling metallic pipes to metallic fitting or valve, no more than three (3) full threads shall show when joint is made up.
- e. Where assembling to threaded plastic fitting, take up joint no more than one full turn beyond hand tight.
- f. Where assembling soft metal (brass or copper) or plastic pipe, use strap type friction wrench only; do not use metal-hawed wrench.

D. Remote Control Valve Installation

- 1. Valves are shown schematically on plan and location shall be verified with Architect in field. Install valves no farther than 12 inches from main line unless absolutely necessary.
- 2. Thoroughly flush main line before installing valve. No soil will be allowed in valve boxes. Install gravel in valve box as shown in details.

E. Automatic Control Wiring

- 1. Run lines along mains wherever practical. Tie wires in bundles with pipe wrapping tape at 10 foot intervals and allow slack for contraction between strappings. Loop a minimum of three (3) feet of extra wire in each valve box; both control wire and ground wire. Tie a 20" loop in all wiring at changes of direction greater than 30'. Untie all loops after all connections have been made.
- 2. Connections shall be made by crimping bare wires with brass connectors and sealing with epoxy resin sealer packs. Splicing will be permitted only on runs exceeding 500 feet. Locate all splices at valve locations.

F. Automatic Controller

- 1. Locate controller in general location shown with exact placement to be determined by the Architect. Connect control lines to controller in sequential arrangement according to assigned identification number of valve. Control lines shall be labeled, on controller and valve box lid, indicating number of valve controlled.

G. Inspection and Tests

- 1. Notify the Architect at least 48 hours in advance of inspection request and testing.

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2. As soon as the mains are connected, flushed and complete, all of the outlets shall be closed and thoroughly tested under the pressure of the existing street system, in the presence of the Architect. No mains shall be covered until they have been inspected and approved by the Architect.
3. Entire system shall be capped and pressurized to 100 psi and shall remain so for a two hour period. Check all joints and connections for leaks. Repair as necessary.
4. Tests shall be observed and approved by the Architect prior to backfill.

H. Backfilling

1. Backfill shall not be placed until the installed Irrigation System has been inspected, approved, and tested in the presence of Architect. Backfill material shall be an approved sandy soil or sand. Unsuitable material, including clods and rocks over 2-1/4 inches in size, shall be removed from the premises and disposed of legally at no cost to the Owner. (Install sand bed 2" below pipe and 4" above if soil conditions are rocky).
2. All backfilling shall be done carefully and shall be properly tamped to 98% compaction and 95% for top 6" of backfill under paving. Compaction of 90% in planters is adequate with the top 12" being top soil.
3. Surplus earth remaining after backfilling shall be disposed of legally off the premises.
4. Where excavating or "jacking" is required under pavement, care shall be taken in backfilling with sand, tamping, and inundating with water.
5. If settlement occurs along trenches, and adjustments in pipes, valves and sprinkler heads, soil, sod or paving are necessary to bring the system, soil, sod or paving to the proper level of the permanent grade, the Contractor, as part of the work under this Contract, shall make all adjustments without extra cost to the Owner.
6. It is recommended that backfill be made first thing in the morning while pipe and soil temperatures are approximately the same. If backfilling is required during heat of day, water shall be run through PVC to cool for contraction of pipe.

I. Sprinkler Head Installation

1. After all sprinkler piping and risers are in place and connected, and prior to the installation of sprinkler heads, control valves shall be opened and water used to flush out the system.

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2. Drip heads above grade shall be installed at their permanent elevation on the up-hill side of plant. Sprinkler heads along walks or curbs shall be installed at their permanent elevation, flush with finish grade at the time of installation. Any adjustment necessary due to settlement will be made during maintenance period.
3. Sprinkler head adjustments shall be made by fully opening the sprinkler farthest from the control valve. The manual adjustment of the control valve shall be opened slightly to obtain a 12-inch high spray at the sprinkler mentioned above. After this condition has been met, all other sprinklers in the section shall be adjusted for equal height sprays, regulating the control valve as required to maintain this condition. With a pressure gauge on the sprinkler first opened, the control valve shall be adjusted to obtain the catalog rated pressure for the sprinkler installed. Individual heads shall then be rotated, as required to keep sprays within the areas of planting. Required for overhead sprinkler spray system only.

J. Coverage Test

1. When the sprinkler system is completed, the Contractor, in the presence of the Architect shall perform a test which indicates the water coverage afforded the planting areas is complete, adequate, and does not sprinkle any walks or paved areas. The Contractor shall furnish all materials and perform all work required to correct any inadequacies disclosed. The Contractor shall inform the Architect of any deviation from the plan required due to wind, planting, soil or site conditions, that bear on complete coverage.

3.02 GUARANTEE

- A. The entire sprinkler system work shall be guaranteed for a period of one (1) year from the date of acceptance of the work. Should any trouble develop within the time specified due to inferior or faulty material or workmanship, the trouble shall be corrected by the Contractor without expense to the Owner.

3.03 RECORD DRAWINGS

- A. The Contractor shall maintain in good order in the field office one complete set of "pink" bond prints of all sprinkler drawings which form a part of the Contract, showing all water lines, sprinklers, valves and controller. The drawings shall be marked "Record Drawings". In the event any work is not installed as indicated on the drawings, such work shall be corrected and dimensioned accurately from the building walls on these record drawings including proper depths.
- B. Upon completion of the work, obtain (2) two sets of "pink" bond prints from the Architect and neatly correct the prints to show the "as-built" conditions, and supply 2 sets to the Architect. The Contractor shall pay for the cost of all prints.

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3.04 INSTRUCTION

- A. After the system has been installed and approved, the contractor shall instruct the Owner in complete operation and maintenance of the irrigation system.

3.05 CLEAN-UP

- A. Remove all debris, dirt, rocks, trash, etc. from paving, sidewalks, and other non-planter areas. Be prepared to wash all paved areas clean with either a water truck or fire hose or other large suitable equipment capable to accomplishing the work quickly.

END OF SECTION

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SECTION 02900

LANDSCAPING

Conditions of the Contract and Division 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.01 SCOPE

- A. The work of this section shall include all labor, materials and equipment required to complete the landscaping work indicated on the drawings and herein specified.
- B. The principal items consist of:
 - 1. Submittals
 - 2. Materials including, but not limited to:
 - a. Topsoil, fertilizers and soil amendments
 - b. Herbicides
 - c. Planting materials and accessory items
 - 3. Plant Installation
 - 4. Plant maintenance for a period of 90 days per this specification
 - 5. Guarantee
 - 6. Fine grade all areas to be landscaped including earth berms
 - 7. Placement of cobble and decomposed granite

1.02 RELATED WORK

- A. Other related work not covered in this section may include, but not be limited to:
 - 1. Underground site utilities
 - 2. Automatic irrigation system
 - 3. Paving
 - 4. Hardscape

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5. Drainage
6. Rough grading

1.03 VISIT TO THE SITE

- A. The Contractor shall visit the site, review the plans and specifications and shall take all measurements and obtain any other information as may be necessary for a complete and conclusive bid. All irrigation systems shall be inspected and approved by Landscape Architect before start of any work of this section.

1.04 PERMITS, FEES, REGULATIONS, LICENSE AND INSURANCE

- A. Landscape Contractor shall obtain and pay for all permits and fees and agency inspections as required including Agricultural Department and submit all acceptance certificates to the Landscape Architect.
- B. All work, materials, and installation shall comply with pertinent codes, regulations, and industry standards.
- C. The Landscape Contractor shall be currently licensed as a C-27 California Landscape Contractor and shall show proof of licensing in the city where work is being performed.
- D. Contractor shall carry all worker's compensation, public liability, and property damage insurance as required by public codes and the General Contractor.

1.05 SUPERVISION AND WORKMANSHIP

- A. The Contractor, personally or through an authorized and competent representative, shall supervise the work constantly. The supervisor shall always maintain a safe and reasonably clean work area, and the workmanship of the entire job shall be first class in every aspect.
- B. The Contractor shall be responsible for the protection of private property at and adjacent to the Work area and shall exercise due caution to avoid damage to such property.
- C. Trees, lawns, and shrubbery that are not to be removed shall be protected from damage or injury. If damaged or removed because of the Contractor's operations, they shall be restored or replaced in as nearly the original conditions and location as is reasonably possible. Replaced lawns shall be sodded, not seeded.

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**1.06 SUBMITTALS BY LANDSCAPE CONTRACTOR
(SEE SECTION 01340)**

A. Soil Tests

It is the responsibility of the Landscape Contractor to inform the Landscape Architect of any adverse soil conditions on site. To insure proper soil conditions for planting, the Landscape Contractor shall submit several soil samples, randomly collected from the site, and sent to Soil and Plant Laboratory in Santa Ana, CA (714) 558-8333 for testing and analysis. Results of testing shall be delivered to the Landscape Architect for approval prior to commencing with soil preparation.

B. Plant Availability List

Within 30 days of signing the contract, the Landscape Contractor shall provide the Landscape Architect with a complete materials list of plants, including complete data on source, size, quantity, and availability. Any substitutions of plant types, species sizes or quantity must be approved by the Landscape Architect prior to this time. If credits or deducts in the contract are required due to substitutions, the Landscape Contractor shall submit these with the materials list submittal.

C. Plant Photos and Specifications

The Landscape Contractor shall provide the Landscape Architect with photos and size specifications of all trees that are not previously tagged off by the Landscape Architect. These trees will be subject to approval by the Landscape Architect. Refer to legend for any other plants requiring photo submittal to the Landscape Architect. Photos shall be submitted to the Landscape Architect a minimum of 90 days prior to commencement of job.

D. Unit Costs

Within 30 days of signing the contract, the Landscape Contractor shall provide the Landscape Architect with an outline of the unit costs of all plant materials and other materials and products as specified. These prices will be the basis for determining additions or subtractions to the contract.

E. Time Schedule

Within 30 days of signing the contract, the Landscape Contractor shall submit a detailed schedule outlining the description of work and the dates for completion to the Landscape Architect, and the General Contractor for coordination of reviews and integration of other work.

PART 2 - MATERIALS

2.01 GENERAL PRODUCTS

The following material shall be used:

- A. Topsoil: Contractor may use on-site topsoil, without admixtures of subsoil, free from rocks, sticks, or other foreign matter as a subsoil in all planters up to within 2" of top of curbs. Imported topsoil shall be fertile, friable local natural topsoil free from subsoil, clay, stems, roots, stones, weeds, and other debris. It shall be delivered in a workable condition. Imported topsoil shall be a minimum of 12" in depth and shall be held 2" below the top of the curbs (for a finished elevation) in all planting areas.
- B. Soil Amendment: Nitrohumus or acceptable substitution.
- C. Granular Fertilizer: Agriform 16-7-12 + iron or approved substitution.
- D. Tablet Fertilizer: Agriform 20-10-5, 21 gram planting tablets or approved substitution.
- E. Mulch: Turf and Tee or acceptable substitution.
- F. Stakes for Trees: As shown in the details.
- G. Pre-Emergent Herbicide: Treflon, Dymid or acceptable substitution.
- H. Cactus Soil Mixture: Cactus soil mixture shall be used only in specified areas and shall consist of: 2 parts builders sand, 1 part pea gravel, 1 part "Nitrohumus," 1/2 part "Perlite." Verify with Landscape Architect.
 - 1. This mixture to be used for all planter tub soil mix to be planted with cacti and all planting areas contaminated with building materials during construction. All tainted soil shall be removed from the site and replaced with this mixture. Mixture shall be installed a minimum of 18" deep.
 - 2. Existing soil not contaminated during construction, as determined by the Landscape Architect, is approved for cacti and succulent planting.
- I. Plant Materials:
 - 1. Quality and sizes: Plants shall be vigorous and of normal habit of growth and shall be free of disease, insects, eggs and larvae. Plants shall equal or exceed the standards as outlined in the California Association of Nurserymen, and applicable California State Codes.
 - a. Nursery grown: Plants shall be nursery grown under climatic conditions similar to those in the locality of the project.

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- b. Pruning: Plants shall not be pruned prior to delivery except upon special approval.
 - c. Ground cover plants shall be rooted plants grown in flats or containers as specified.
 - d. Inspection: Plants shall be inspected and approved by the Landscape Architect at the site upon delivery. Such approval, for quality, size and variety shall not preclude the right of inspection and rejection at the site during progress of work, for the size and condition of root balls, latent defects or injuries.
- J. Tree Root Barriers
- 1. Deep Root™ control barriers or approved equal available at Deep Root Corporation (213) 390-1060.

PART 3 - EXECUTION

3.01 PLANTING INSTALLATION

The following planting installation procedures shall be followed, and no planting shall be done during unfavorable weather.

- A. Rough grading and topsoil
 - 1. Remove all growth of vegetation, debris and stones larger than 1" in diameter from all areas to be planted. Work in topsoil as required.
 - 2. Cultivate planting area to 6" depth, and grade so that finish grade is 1" below adjacent paving or 2" for shrub beds.
- B. Soil preparation:
 - 1. Spread 2 cu. yards of soil amendment and 12 pounds of commercial fertilizer per 1000 square feet in all planting areas except cacti/succulents and cultivate to depth of 6" in two directions, so additive is uniformly mixed. Water shall be applied if necessary, to bring soil to ideal moisture content for tilling and planting.
- C. Staking:
 - 1. Plant locations as shown on drawings shall be staked out and approved by the Landscape Architect before any installation begins.
- D. Tree and shrub excavations, or "plant holes" shall be square, with vertical sides as indicated on the details.

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1. Place plant in pit centered, upright and faced to give the best appearance or relationship to adjacent plants or structures. Roots shall be placed in their normal position, and plant shall rest on solid soil to such a depth that the finished grade level at the plant after settlement will be the same as that at which the plant was grown. Add prepared backfill around the plant and compact carefully to avoid injury to the roots and fill all voids. When the hole is 2/3 filled, add water as necessary for settlement. Repeat the operation until the soil level is at the finish grade of the plant.
 2. Form a temporary shallow saucer or dyke around each plant of sufficient size to allow thorough watering if plants are to be hand watered until the irrigation system is operational, add a 2" layer of soil amendment and lightly cultivate into the soil as a mulch.
 3. Bare root cacti or succulent roots shall be treated with sulfur prior to planting.
- E. Ground cover areas shall have 2" of soil amendment thoroughly mixed and tilled into the top 6" of soil. Plants shall be evenly spaced in neat rows and not allowed to dry out. Upon completion of planting, they shall be kept watered with a fine spray only, and care shall be taken that the plants are not sprayed in direct sun.
- F. Landscape Contractor shall meet with the Landscape Architect prior to planting to establish correct planting procedures. This includes: plant care, handling, damage (replacement and guarantees), soil preparation, root pruning, irrigation system, initial watering, and watering schedules. This is critical for palms and cacti/succulent planting.
- G. Provide Stakes and Tree Guards and Root Guards as shown in details or as directed by the Landscape Architect.
- H. Watering: Plants shall not be allowed to dry out before or while being planted. Water plants immediately after planting, and thereafter until acceptance of work. Refer to item L for cacti/succulents.
- I. Remove all containers, boxes, straps, non-essential stakes, trellises, etc. from plants and remove from site.
- J. Treat all planted areas, gravel, and rock/cobble areas with pre-emergent weed agent per manufacturer's specifications.
- K. Apply 1" of specified mulch to all planting beds except "raked earth", decomposed granite, or "cobbled" areas.
- L. Verify the soil amending, watering, and fertilizing of all cacti and succulents with the Landscape Architect prior to planting.

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- M. Plants that show signs of failure to grow, or injured plants shall be replaced immediately.

3.02 MAINTENANCE

- A. A preliminary inspection by Landscape Architect to determine the condition of plants will be made when all plants have been installed, and Landscape Architect will indicate acceptance in writing at that time.
- B. Upon approval of the above, the 90 day maintenance period shall begin. This shall include weeding, cultivating, fertilizing, pruning, and watering as necessary to maintain plantings. Protect plantings against damage including erosion. Contractor shall not be held responsible for acts of malicious mischief.
- C. At the conclusion of the 90 day maintenance period, a final inspection shall be made for final approval. All ground cover areas shall be treated with pre-emergence weed killer at beginning and end of the maintenance period.
- D. Replace all dead and missing plants.

3.03 GUARANTEE AND CLEAN-UP

- A. All plant materials shall be guaranteed for 90 days from FINAL ACCEPTANCE date. Boxed trees shall be guaranteed for (12) months. All plants not in vigorous growing condition including ground cover, as determined by the Landscape Architect, shall be replaced immediately.
- B. The entire site of the work shall be kept clean at all times. Upon completion remove all excess soil, stones, debris from the site and leave in a well finished condition at the close of the job.

END OF SECTION

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SECTION 02990

LANDSCAPE ACCESSORIES – DECOMPOSED GRANITE

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment and services for all landscape accessories, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Work to Include:

1. Selection and placement.
2. Excavation, compaction and grading for placement.
3. Review by Landscape Architect of selection and placement.
4. Coordination with other trades.
5. Site storage of materials.

C. Related Work:

1. See Section 02810 - Automatic Irrigation System.
2. See Section 02900 - Landscaping.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Decomposed granite color and quantity as indicated on drawings.

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- B. Soil treatment with pre-emergent herbicide: Surflan, Diazanone, or acceptable alternate.

PART 3 - EXECUTION

3.01 GENERAL

- A. Treat soil with pre-emergent herbicide at decomposed granite locations as directed by Landscape Architect.
- B. Landscape Contractor shall be responsible for supplying all decomposed granite as shown on the plan. Landscape Architect will review and accept these materials prior to delivery to the site.
- C. The Landscape Contractor shall be responsible for:
 - 1. Selection and placement of all decomposed granite used on site.
 - 2. Any excavation and fine grading necessary to set the decomposed granite.
- D. The decomposed granite shall be installed at a minimum depth of 1 ½" over a smoothly graded compacted soil subgrade. Once the decomposed granite is spread in a uniform manner to a consistent depth, it shall be thoroughly watered to wet the full thickness of the decomposed granite and compacted to form an even solid cover.

3.02 CLEAN UP

- A. Provide clean up and off-site removal of any unused material.
- B. Coordinate work with landscape contractor.

END OF SECTION

**DIVISION 3
CONCRETE**

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SECTION 03000

CONCRETE - GENERAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment and services for all concrete work as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Definition:

1. Concrete work: Cast-in-place structural concrete for use in buildings, paving, and appurtenances. Specific aspects of concrete work are specified in other sections:
 - a. Concrete Formwork: Section 03100.
 - b. Concrete Reinforcement: Section 03200.
 - c. Cast-in-Place Concrete: Section 03300.
 - d. Concrete Mixing, Placing, Jointing and Curing: Section 03310.
 - e. Concrete Finishing and Repair of Surface Defects: Section 03350.
2. Acceptable or permitted: Accepted or permitted by Architect.
3. Exposed construction: Exposed to view.
4. Exposed to public view: Situated so that it can be seen from eye level from a public location after completion of building. A public location is accessible to persons not responsible for operation or maintenance.

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5. Normal weight concrete: Concrete for which density is not a controlling attribute, made with aggregates of types covered by ASTM C33, usually having unit weights in range of 135 to 160 PCF.
 6. Required: Required by Contract Documents.
 7. Submitted: Submitted to Architect/Engineer for review.
 8. Other words and terms used in these specifications: As defined in ACI SP-19.
- C. The provisions of these specifications govern wherever applicable to conditions and types of work that occur on particular job except as otherwise provided in Contract Documents. In case of conflicting requirements, Contract Documents govern.
- D. Design criteria:
1. CBC, (California Building Code) latest edition.

1.02 JOB CONDITIONS

- A. Do not allow construction loads to exceed superimposed load which member, with necessary supplemental support, is capable of carrying safely and without damage. Amount, method of distributing, and proposed supplemental support of loads during construction is responsibility of Contractor.

1.03 PLACING CONCRETE

- A. Notify Architect minimum 24 hours prior to commencement of concreting operations, to allow for visual review of reinforcing.
- B. Install vapor barrier under interior floor slabs on fill. Lap joints minimum 4 inches and seal. Do not disturb vapor barrier while placing reinforcement. See section 07110 for vapor barrier.

1.04 CONCRETE MIX

GENERAL:

- A. Mix concrete in accordance with ASTM C94.
- B. Foundation Concrete:
1. Compressive Strength (7 days): 1500 psi
 2. Compressive Strength (28 days): 2500 psi

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3. Slump: 4 inch maximum

C. Slab on grade:

1. Compressive Strength (7 days): 1500 psi
2. Compressive Strength (28 days): 2500 psi
3. Slump: 4 inch maximum

D. Curbs and Gutters Concrete:

1. Compressive Strength (7 days): 1500 psi
2. Compressive Strength (28 days): 2500 psi
3. Slump: 4 inch maximum

1.05 TESTS

- A. Submit proposed mix design of each class of concrete to Architect for review/approval prior to commencement of work.
- B. Three concrete test cylinders will be taken for every 75 or more cubic yards of each class of concrete placed each day.

END OF SECTION

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SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all formwork as required, as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Use forms, wherever necessary, to confine concrete and shape it to required dimensions. Use forms of sufficient strength to withstand pressure resulting from placement and vibration of concrete, with sufficient rigidity to maintain specified tolerances.

C. See concrete finish requirements in Section 03350.

D. Use earth side forms for spread footings, pile caps and unfinished grade beams where earth can be shaped to a straight and true surface. Comply to earth side form detail on structural drawings.

E. Design and engineering of formwork, as well as its construction, is responsibility of Contractor.

1. Shoring and reshoring shall be designed and sealed by a Professional Engineer, currently registered in California, and having experience in this work.
2. Design formwork for loads, lateral pressure, and allowable stresses outlined in ACI 347. Formwork design shall also satisfy applicable requirements of the local building code.
3. Develop shoring and reshoring pattern and sequence so as not to exceed safe structural capacity of supporting structural systems.

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1.02 TOLERANCES

- A. Construct formwork so that concrete surfaces will conform to tolerance limits listed: All tolerances non-cumulative.
1. Variation from plumb:
 - a. In the lines and surfaces of columns, piers, walls, and in arrises:
 - (1) In any 10 ft. of length (1 in 500): 1/4"
 - (2) Maximum for entire length: 1".
 - b. Variation from level or from grades specified:
 - (1) In any 20 ft. length (1 in 1000): 1/4"
 - (2) Maximum for entire length = 1/2".
 2. Variation from level or from grades specified:
 - a. In slab soffits, ceilings, beam soffits and in arrises, measured before removal of supporting shores.
 - (1) In any 10 ft. of length (1 in 500): 1/4"
 - (2) In any bay or in any 20 ft. length (1 in 750): 3/8"
 - (3) Maximum for entire length: 3/4"
 - b. In exposed lintels, sills, parapets, horizontal grooved, and other conspicuous lines:
 - (1) In any bay or in 20 ft. length (1 in 1000): 1/4"
 - (2) Maximum for entire length: 1/2"
 3. Variations from true plans of concrete surface exposed to view caused by bulging of form facing material between supports:
 - a. 3/16" or 1/300 of the span between supports whichever is smaller.
 4. Variation of linear building lines from established position in plan and related position of columns, walls, and partitions:
 - a. In any bay: 1/2"

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- b. In any 20 ft. of length (1 in 50): 1/2"
- c. Maximum for entire length: 1"
- 5. Variation in sizes and location of sleeves, floor openings, and wall openings.
 - a. Plus or minus: 1/4"
- 6. Variation in cross-sectional dimensions of columns and beams and in thickness of slabs and walls:
 - a. Plus or minus: 1/4"
- 7. Footings:
 - a. Variations in dimensions in plan:
 - (1) Minus: 1/2"
 - (2) Plus: 2"
 - b. Misplacement or eccentricity:
 - (1) 2% of footing width in direction of misplacement but not more than 2".
 - c. Thickness:
 - (1) Decrease in specified thickness: 5%
 - (2) Increase in specified thickness: No limit (except that which may interfere with other construction).
- 8. Variation in steps:
 - a. In a flight of stairs:
 - (1) Rise: 1/8" plus or minus
 - (2) Tread: 1/8" plus or minus
 - b. In consecutive steps:
 - (1) Rise: 1/16" plus or minus
 - (2) Tread: 1/8" plus or minus

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- B. Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.
- C. Establish and maintain in an undisturbed condition and until final completion and acceptance of project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
- D. Regardless of tolerances listed allow no portion of building to extend beyond legal boundary of project.

1.03 SUBMITTALS

- A. Sealed and signed statement from Professional Engineer that he is experienced in the design of formwork and to the best of his knowledge he has designed the formwork, shoring and reshoring in accordance with the recommendations of ACI 347 and these specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Form facing materials: As indicated under description of finishes required in section 03350.

2.02 FABRICATION OF FORMS

- A. Make forms sufficiently tight to prevent loss of cement fines. Place 1/2" chamfer strips in corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on such surfaces and edges of formed joints will not require beveling.
- B. To maintain specified finish tolerances, camber formwork to compensate for anticipated deflections.
- C. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation. Securely brace forms against lateral deflection.
- D. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.
- E. Form accessories to be partially or wholly embedded in concrete, such as ties and hangers, shall be of a commercially manufactured type. Do not use nonfabricated wire. Use form ties constructed so that ends or end fasteners can be removed without causing appreciable spalling of concrete faces. After ends

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or end fasteners of form ties have been removed, embedded portion of ties shall terminate not less than 2 diameters or twice minimum dimension of tie from formed faces of concrete to be permanently exposed to view, but in no case less than 3/4". When formed face of concrete is not to be permanently exposed to view, form ties may be cut off flush with formed surfaces. Use ties with 3/4" dia. cones on both ends for water retaining structures.

- F. At construction joints, contact surface of form sheathing for flush surfaces exposed to view shall overlap hardened concrete in previous placement minimum 1". Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
- G. Fasten wedges (used for final adjustment of forms prior to concrete placement) in position after final check.
- H. Anchor formwork to shores or other supporting surfaces of members so that upward or lateral movement of any part of formwork system is prevented during concrete placement.

PART 3 - EXECUTION

3.01 PREPARATION OF FORM SURFACES

- A. Clean all form surfaces and embedded materials of mortar, grout and foreign material before concrete is placed.
- B. Unless otherwise specified or approved, treat surfaces of forms as follows:
 - 1. Before placing of reinforcing steel or concrete, cover surfaces of forms with an approved coating material that will effectively prevent absorption of moisture and prevent bond with concrete, and not stain concrete. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
 - 2. Do not allow excess form coating material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
 - 3. Apply surface retarder agents in accordance to Section 03350 - Concrete Finishing and Repair of Surface Defects.

3.02 REMOVAL OF FORMS

- A. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

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- B. Remove top forms for wall openings as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces at once, followed by specified curing.
- C. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- D. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- E. Where no reshoring is planned, leave forms and shoring, used to support weight of concrete in beams, slabs and other concrete members, in place until concrete has attained its specified strength. Where reshoring is planned, supporting formwork may be removed when concrete has reached 70 percent of specified strength, provided reshoring is installed immediately.
- F. When shores and other vertical supports are so arranged that non-load-carrying form-facing material may be removed without loosening or disturbing shores and supports, facing material may be removed at an earlier age as per mitted.

3.03 REMOVAL STRENGTH

- A. When removal of formwork is based on concrete reaching a specified strength, concrete shall be presumed to have reached this strength when either of following conditions has been met.
 - 1. When test cylinders, field cured along with concrete they represent, have reached specified strength.
 - 2. When concrete has been as specified for same length of time as age at test of laboratory-cured cylinders which reached specified strength. Determine length of time concrete has been cured in structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which temperature of air in contact with concrete is above 50 degF and concrete has been damp or sealed from evaporation and loss of moisture.

END OF SECTION

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SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment and services for all concrete reinforcement as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.
5. See Section 03000 for general requirements for concrete work.

1.02 QUALITY ASSURANCE

A. Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

1. Sheared length: plus or minus 1".
2. Depth of truss bars: plus 0, minus 1/2"
3. Overall dimensions of stirrups, ties, and spirals: plus or minus 1/2".
4. All other bends: plus or minus 1".

B. Place bars to following tolerances:

1. Clear distance to formed surfaces: plus or minus 1/4".
2. Minimum spacing between bars: 1/4".
3. Top bars in slabs and beams:

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- a. Members 8" deep or less: plus or minus 1/4".
 - b. Members between 8" and 2' deep: plus or minus 1/2".
 - c. Members more than 2' deep: plus or minus 1".
4. Crosswise of members: spaced evenly within 2".
 5. Lengthwise of members: plus or minus 2".
- C. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to review and approval.
- D. Welding standards: American Welding Society (AWS) D1.4-79 Structural Welding Code-Reinforcing Steel.

1.03 SUBMITTALS

- A. Shop drawings: Do not submit shop drawings for review unless reinforcing is changed from Contract Documents.
1. Shop drawings, showing dimensions and locations of reinforcing steel accessories, in sufficient detail to permit installation of reinforcing without reference to Contract drawings.
 - a. Details of concrete reinforcement and accessories not shown on Contract Documents must be in accord with ACI 315.
- B. Project data:
1. Certified mill test reports for all reinforcing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Acceptable manufacturers:
1. Materials listed.
 - a. Base: As noted.
- B. Reinforcing General: Grade 60 KSI and Grade 40 KSI, see structural drawings for rebar size related to the grade conforming to ASTM A615-82(S1) - Standard

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Specifications for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement including Supplementary Requirements on structural sheet S1.1, of construction drawings.

- C. Welded Reinforcing: All reinforcing to be welded shall conform to ASTM A706-82a unless the "Cadwelding" Procedure is used. ICBO Report NO. 1693.
- D. Protecting reinforcing: Where indicated provide reinforcing protection.
- E. Welded wire fabric: Flatsheets; conform to gage and mesh size of plain or deformed wire indicated, and ASTM A185, except that welded intersections shall be spaced not farther apart than 12" in direction of principal reinforcement.
- F. Smooth dowel bars for construction joints: Conform to ASTM A306, Grade 60. Where indicated, provide a metal dowel cap at one end of dowel to permit longitudinal movement of dowel within concrete section. Provide for movement which equals joint width plus 1/2" Unless otherwise indicated, use 5/8" diameter dowels spaced 18" o.c..
- G. Wire: Cold-drawn steel wire for concrete reinforcement, ASTM A82-79.

PART 3 - EXECUTION

3.01 WELDING

- A. Perform all welding of reinforcing steel in conformance with AWS D1.4.
- B. Have each welder place an approved identification mark near each completed weld.
- C. Cut out welds determined to be defective and reweld and retest at no additional cost to Owner.

3.02 WELDING TESTING

- A. A licensed deputy inspector shall be required for field inspection of all "Full penetration" welds.

3.03 PLACING REINFORCEMENT

- A. Provide minimum concrete covering for reinforcement as follows:
 - 1. Concrete deposited against earth: 3".
 - 2. Formed surfaces exposed to weather or in contact with earth; 2" for reinforcing bars No. 6 or larger; 1 1/2" for reinforcing bars less than No. 6.

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3. Interior surfaces: 1-1/2" for beams, girders, and columns; 3/4" for slabs, walls and joists with No. 11 bars or smaller, and 1-1/2" with No. 14 and No. 18 bars.
- B. Assure that all reinforcement, at time concrete is placed, is free of materials that may adversely affect or reduce bond. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights, including heights of deformations, or a cleaned sample is not less than required by applicable ASTM.
- C. Support all reinforcement and fasten together to prevent displacement by construction loads or placing of concrete beyond tolerances indicated. On ground, provide supporting concrete blocks or other approved method. Over formwork, use concrete, metal, plastic or other approved bar chairs and spacers. Where concrete surface will be exposed to weather in finished structure, furnish all accessories within 1/2" of concrete surface of noncorrosive material or protect against corrosion.
- D. Overlap welded wire fabric reinforcement wherever successive mats are continuous, in such a way that overlap measured between outermost cross wires of each fabric sheet is not less than spacing of cross wires plus 2". Support as required for reinforcing bars. Do not "lift" into place during concrete placement.
- E. Offset vertical bars in columns at least one bar diameter at lapped splices. To insure proper placement, furnish templates for all column vertical bars and dowels.
- F. All splices not specifically indicated shall be subject to approval. Mechanical connectors for reinforcing bars may be used subject to approval.
- G. Unless permitted by Architect do not bend reinforcement after bedding in hardened concrete.
- H. Do not tack weld reinforcing.

END OF SECTION

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all concrete materials and proportioning as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.
5. See Section 03000 for general requirements for concrete work.

1.02 QUALITY ASSURANCE

A. Materials standards:

1. ASTM C33-90: Concrete Aggregates.
2. ASTM C94-90: Ready-mixed Concrete.
3. ASTM C150-89: Portland cement.
4. ASTM C260-86: Air-Entraining Admixtures for Concrete.
5. ASTM C494-86: Chemical Admixtures for Concrete.

B. Testing standards:

1. ASTM C39-86: Compressive Strength of Cylindrical Concrete Specimens.
2. ASTM C109-90: Test for Compressive strength of Hydraulic Cement Mortars.

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3. ASTM C138-81: Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
4. ASTM C143-90: Test for Slump of Portland Cement Concrete.
5. ASTM C173-78: Test for Air content of Freshly Mixed Concrete by the Volumetric Method.
6. ASTM C192-90: Making and Curing Concrete Test Specimens in the Laboratory.
7. ASTM C231-89: Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
8. ASTM C157-89: Drying shrinkage test.

C. Proportioning standards:

1. ACI 211.1-81: Standard Practice for Selecting Proportions for Normal and Heavy weight Concrete.

1.03 SUBMITTALS

A. Related Sections

1. Section 01010, Special Conditions, paragraph 1.13.
2. Section 01400, General Testing Procedures.
3. Section 01340, Shop Drawings, Product Data, Samples and Project Data

B. Product data:

1. Mix design: To be submitted to Architect for review prior to any concrete being poured. Different mix designs shall be prepared for the various concrete conditions and shall include foundation work. See Section 03000-1.04.
 - a. Proportioning of all materials.
 - b. Mill certificates for cement.
 - c. Slump.
 - d. Air entrainment.
 - e. 7 and 28 day compression test results.

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- f. Unit weights of fresh and dry lightweight concrete.
- g. Sieve analysis and source of fine and coarse aggregates.
- h. Test for aggregate organic impurities.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cement: Portland cement, ASTM C150 Type I or II, low alkali. Cement used shall correspond to that upon which selection of concrete proportions was based.
- B. Admixtures: When required or permitted, conform to appropriate specifications listed below; admixtures used shall be of same composition as used in establishing required concrete proportions.
 - 1. Air-entraining admixtures: ASTM C260.
 - 2. Water-reducing, retarding, and accelerating admixtures: ASTM C494. Use water-reducing, retarding, or accelerating admixtures that are all manufactured by the same company.
 - 3. Pozzolanic admixtures: ASTM C618. **Use no more than 15% by weight.**
 - 4. Do not use admixtures containing calcium chloride.
- C. Water: Potable. **Water to cement ratio shall not exceed .50.**
- D. Aggregates:
 - 1. Normal weight concrete: ASTM C33.
 - 2. Any suitable individual grading of coarse aggregates for normal weight concrete may be used provided the "Grading of Combined Aggregates" shown in the following table are obtained:

GRADING OF COMBINED AGGREGATES

Sieve Number of Size in Inches	1-1/2" Max.	1" Max.	3/4" Max.
Passing a 2"	--	--	--
Passing a 1-1/2"	95-100	--	--
Passing a 1"	75-90	90-100	--
Passing a 3/4"	55-77	70-90	90-100

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Passing a 3/8"	40-55	45-65	60-80
Passing a No. 4	30-40	31-47	40-60
Passing a No. 8	22-35	23-40	30-45
Passing a No. 16	16-30	17-35	20-35
Passing a No. 30	10-20	10-23	13-23
Passing a No. 50	2-8	2-10	5-15
Passing a No. 100	0-4	0-3	0-5

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

- A. Store cement in weather tight buildings, bins, or silos which will exclude moisture and contaminants.
- B. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates. To insure that this condition is met, perform any test for determining conformance to requirements for cleanliness and grading on samples secured from aggregates at point of batching. Do not use frozen or partially frozen aggregates.
- C. Allow natural or manufactured sand to drain until it has reached a relatively uniform moisture content before use.
- D. Store admixtures in manner to avoid contamination, evaporation, or damage. For those used in form of suspensions or non-stable solutions, provide agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and temperature changes which would adversely affect their characteristics.

3.02 PROPORTIONING

- A. General: Use concrete of specified quality capable of being placed without excessive segregation and, when cured, of developing all characteristics required.
- B. Strength: Specified strength and type of concrete for each use in structure(s) shall be as noted on drawings.
- C. Durability:
 - 1. Entrain air in concrete of normal weight to within air content limits of following Table as measured in accord with ASTM C231, ASTM C173, or ASTM C138.

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TOTAL AIR CONTENT FOR VARIOUS SIZES OF COARSE
 AGGREGATE FOR NORMAL WEIGHT CONCRETE

Nominal maximum size of coarse aggregate	Size No.	Total air content, percent by volume
3/8"	8	6-10
1/2"	7	5-9
3/4"	67	4-8
1"	57	3.5-6.5
1-1/2"	467	3-6
2"	357	2.5-5.5
3"	---	1.5-4.5

- D. Slump: Proportion and produce concrete to have a slump of 5" maximum. Concrete of lower than usual slump may be used provided it is properly placed and consolidated. Determine slump per ASTM C143.
- E. Maximum size of coarse aggregate: Nominal maximum size of aggregate; not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourths of minimum clear spacing between reinforcing bars. These limitations may be waived if, in judgment of Architect, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids. Maximum coarse aggregate sizes:
 - 1. Footings: 1-1/2"
 - 2. Foundation walls, slab on grade: 1"
 - 3. Structural slabs, joists, beams, girders, or columns: 1"
- F. Admixture: Use admixtures in accord with manufacturer's instructions.
- G. Water to Cement Ratio: **Shall not exceed .50.**
- H. Fly Ash Content: **Shall not exceed 15% by weight.**

3.03 SELECTION OF PROPORTIONS

- A. General: Proportion ingredients to produce a mixture which will work readily into corners and angles of forms and around reinforcement by methods of placing and consolidation employed on work, but without permitting materials to segregate or excessive free water to collect on surface. Proportion ingredients to produce proper placeability, durability, strength, and other required properties.

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1. Comply with following MINIMUM cement contents:

SPECIFIED STRENGTH (psi)	MINIMUM CEMENT CONTENT (sacks/cy)	WEIGHT (Lb/Cy)
2000	5	470
2500	5	470
3000	5-1/2	517
3500	6	564
4000	6-1/2	611
4500	7	658
5000	7-1/2	705

END OF SECTION

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SECTION 03310

CONCRETE MIXING, PLACING, JOINTING AND CURING

PART 1 - GENERAL

1.01 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment and services for all concrete mixing, placing, jointing and curing as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.
5. See Section 03000 for general requirements for concrete work.

1.02 QUALITY ASSURANCE

A. Materials standards:

1. ASTM C171-86: Sheet Materials for Curing Concrete.
2. ASTM C309-89: Liquid Membrane-Forming Compounds for Curing Concrete.
3. ASTM D1751-83: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
4. ASTM D1752-84: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Concrete.

B. Production standards:

1. ASTM C94-90: Ready-mixed concrete.
2. ACI 305R-77: Hot Weather Concreting.

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3. ACI 306R-78: Cold Weather Concreting.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete materials and proportioning: See Section 03300.
- B. Expansion joint filler, premolded: Type required, conforming to ASTM D1751 or D1752.
- C. Waterstops: Manufactured from virgin polyvinyl chloride not containing any scrap or reclaimed material or pigment. Properties of polyvinyl chloride compound shall comply with Corp. of Engineers Spec. CRD-C572. Burke, or acceptable substitute.
 1. Provide in maximum practicable length to minimize end joints.
 2. Butt splice joints at intersections and at ends of pieces in accord with manufacturer's instructions. Make joints to develop effective water tightness fully equal to that of continuous waterstop material, to permanently develop not less than 50 percent of mechanical strength of parent section, and permanently retain flexibility.
- D. Curing compound: ASTM C309. Where concrete floors are to be left exposed use the following:
 1. L & M Construction Chemicals "Dress & Seal".
 2. Sonneborn "Kure-N-Seal".
 3. W.R. Meadows "CS-309".
 4. Protex "Acryseal".
- E. Curing material, sheet: ASTM C171.
- F. Moisture barrier: Polyethylene sheet not less than 6 mils thick. See Section 07110-2.01.

2.02 MIXING AND PRODUCTION OF CONCRETE - READY-MIXED CONCRETE

- A. Batch, mix and transport ready-mixed concrete in accord with ASTM C94. Plant equipment and facilities shall conform to "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association, 900 Spring Street, Silver Spring, MD 20910.

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B. Mix Designs:

1. Mix designs shall be prepared by a Registered California Professional Engineer which fulfill the specified requirements for strength, aggregate size and workability of concrete.
2. Coarse and fine aggregates for pump mixes shall comply with ASTM C-33. Sand must contain adequate fines, with fifteen to thirty percent passing the No. 50 screen, five to ten percent passing the 100-mesh and a fineness modulus between 2.40 and 3.00.
3. Air-entraining or water-reducing admixture shall be used in all concrete which is placed by pumping methods.

2.03 MIXING AND PRODUCTION OF CONCRETE - SITE-MIXED

A. Batching:

1. Use scales for weighing concrete ingredients accurate within plus/minus 0.4 percent of their total capacities. Make standard test weights available to permit checking scale accuracy.
2. Operate batching equipment so that concrete ingredients are consistently measured within following tolerances:

Cement	plus/minus 1 percent
Water	plus/minus 1 percent
Aggregates	plus/minus 2 percent
Admixtures	plus/minus 3 percent
3. Charge each batch into mixer so some water will enter in advance of cement and aggregates. Allow water to flow for a period which may extend to end of first 25 percent of specified mixing time. Provide controls to prevent batched ingredients from entering mixer before previous batch has been completely discharged.

B. Mixing:

1. Mix concrete in a batch mixer capable to thoroughly combining aggregates, cement, and water into a uniform mass within specified mixing time, and of discharging concrete without harmful segregation. Use mixer bearing a manufacturer's rating plate indicating capacity and recommended revolutions per minute. Operate in accord therewith.
2. Use mixers with a rated capacity of 1 cu. yd. or larger conforming to requirements of Plant Mixer Manufacturers Division (1970) of Concrete

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Plant Manufacturers Bureau, 9000 Spring Street, Silver Spring, MD
20901.

3. Except as provided below, mix batches of 1 cu. yd. or less, not less than 1 minute. Increase mixing time 15 seconds for each additional cu. yd. or fraction thereof.
4. Shorter mixing time may be permitted provided performance tests made in accord with ASTM C94 indicate that time is sufficient to produce uniform concrete.
5. Provide controls to insure that batch cannot be discharged until required mixing time has elapsed. At least three-quarters of required mixing time shall take place after last mixing water has been added.
6. Keep interior of mixer free of accumulations that will interfere with mixing action. Replace mixer blades when they have lost 10 percent of their original height.

2.04 MIXING - CONTROL OF ADMIXTURES

- A. Charge air-entraining admixtures and other chemical admixtures into mixer as solutions. Measure by means of an approved mechanical dispensing device. Liquid added shall be considered a part of mixing water. Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
- B. If two or more admixtures are used, add them separately to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
- C. Complete addition of retarding admixtures within 1 minute after addition of water to cement has been completed, or prior to beginning of last three-quarters of required mixing, whichever occurs first.

2.05 MIXING - TEMPERING AND CONTROL OF MIXING WATER

- A. Mix concrete only in quantities for immediate use. Discard concrete which has set.
- B. When concrete arrives at project with slump below that suitable for placing, water may be added only if neither maximum permissible water-cement ratio nor maximum slump is exceeded. Incorporate water by additional mixing equal to at least half of total mixing required.

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2.06 MIXING - WEATHER CONDITIONS

A. Cold weather: Comply with ACI 306.

1. In cold weather, temperature of concrete when delivered at site shall conform to following limitation:

Min. Concrete Temperature
(Degrees F)

Air Temperature (deg F)	For Sections w/least dim. less than 12"	For Sections w/least dim. 12" or greater
30 to 45	60	50
0 to 30	65	55
below 0	70	60

2. If water or aggregate is heated above 100 degF, combined water with aggregate in mixer before cement is added. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 100 degF.

B. Hot weather: Comply with ACI 305. Cool ingredients before mixing, or add flake ice or well-crushed ice of a size that will melt completely during mixing for all or part of mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.

PART 3 - EXECUTION

3.01 PREPARATION BEFORE PLACING

- A. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment.
- B. Complete formwork, remove snow, ice and water, secure reinforcement in place, position expansion joint material, anchors, and other embedded items and have entire preparation approved.
- C. Sprinkle semiporous subgrades to eliminate suction and seal porous subgrades in an approved manner.

3.02 PROTECTION

- A. Unless adequate protection is provided and approval is obtained, do not place concrete during rain.

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- B. Do not allow rainwater to increase mixing water nor to damage surface finish.
- C. When temperature of surrounding air is expected to be below 40 degF during placing or within 24 hours thereafter, temperature of plastic concrete, as placed, shall be no lower than 55 degF for sections less than 12" in any dimension nor 50 degF for any other sections. Temperature of concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90 degF. When temperature of concrete exceeds 90 degF use precautionary measures approved by Architect. When temperature of steel is greater than 120 degF spray steel forms and reinforcement with water just prior to placing concrete.

3.03 CONVEYING

- A. Handle concrete from mixer to place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and assure that required quality of concrete is maintained.
- B. Use truck mixers, agitators, and nonagitating units conforming to ASTM C94.
- C. Use horizontal belt conveyors or mount at a slope which will not cause excessive segregation or loss of ingredients. Protect concrete against undue drying or rise in temperature. Use an approved arrangement at discharge end to prevent segregation. Do not allow mortar to adhere to return length of belt. Discharge long runs into a hopper or through a baffle.
- D. Use approved trunks or chutes where drop exceeds 6 ft.
- E. Pumping equipment shall be of conventional concrete pump with adequate pumping capacity and sufficient pipeline diameter for the maximum size aggregate in concrete. Loss of slump in pumping equipment shall not exceed 2". Do not convey concrete through pipe made of aluminum or aluminum alloy. **By definition, a conventional concrete pump does not include "grout pump," and a "grout pump" will not be allowed to convey concrete.**
- F. Pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Control pneumatic placement so that segregation is not apparent in discharged concrete. Loss of slump in pneumatic conveying equipment shall not exceed two inches.

3.04 DEPOSITING

- A. General: Deposit concrete continuously or in layers of such thickness that no concrete is deposited on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If a section cannot be placed continuously, locate construction joints as indicated. If not indicated, not over 20 ft. o.c.. Place at such a rate that concrete which is being integrated with

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fresh concrete is still plastic. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials. Remove temporary spreaders in forms when concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in concrete only if made of metal or concrete and if prior approval has been obtained.

- B. Do not start placing of concrete in supported elements until concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.
- C. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.
- D. Consolidation. Consolidate all concrete by vibration, so that concrete is thoroughly worked around reinforcement, around embedded items and into corners of forms eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Use internal vibrators having minimum frequency of 8000 vibrations per minute to consolidate concrete effectively. Do not use vibrators to transport concrete within forms. Insert vibrators and withdraw at points approximately 18" apart. At each insertion allow duration sufficient to consolidate concrete but not sufficient to cause segregation; generally from 5 to 15 sec. Keep a spare vibrator on job site during all concrete placing operations. Where concrete is to have an as-cast finish, bring a full surface of mortar against form by vibration process, supplemented if necessary by spading, to work coarse aggregate back from formed surface.

3.05 JOINTS AND EMBEDDED ITEMS

- A. Construction joints: Locate joints not indicated so as to least impair strength of structure, subject to Architect approval.
 - 1. In general, locate near middle of spans of slabs, beams, and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice width of beam. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, 1-1/2" minimum above tops of footings and at tops of floor slabs. Place beams, girders, brackets, column capitals, haunches, and drop panels at same time as slabs. Make joints perpendicular to main reinforcement.
 - 2. Continue all reinforcement across joints. Provide inclined dowels as directed by Architect. Surface of concrete shall be roughened to 1/4" amplitude in all joints in walls and between walls and slabs or footings not earlier than 5 days after initial pour or by an approved method that will assure equal bond such as a thorough hose washing of the surface not less than two or more than four hours after the concrete is placed (depending on setting time).

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3. Clean surface of concrete at all joints thoroughly and remove all laitance prior to placing adjoining concrete.
 4. When required or permitted, obtain bond by one of following methods:
 - a. Use of an approved adhesive.
 - b. Use of an approved chemical retarder which delays but does not prevent setting of surface mortar. Remove retarded mortar within 24 hr. after placing to produce a clean exposed aggregate bonding surface.
- B. Expansion joints: Do not permit reinforcement or other embedded metal items bonded to concrete (except dowels in floors bonded on only one side of joints) to extend continuously through any expansion joints as indicated. If not indicated, locate not over 15 ft. on center.
- C. Place all sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to concrete placement.
1. Give all contractors whose work is related to concrete, or supported by it, ample notice and opportunity to introduce and/or furnish embedded items before concrete placement.
 2. Position expansion joint material, waterstops, and other embedded items accurately and support against displacement. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete.

3.06 BONDING OF JOINTS

- A. When specified, prepare surface of joints in accord with one of methods specified under joints and embedded items.
- B. Dampen (but do not saturate) hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below, immediately prior to placing of fresh concrete.
- C. Dampen (but do not saturate) hardened concrete of joints in exposed work; joints in middle of beams, girders, joists, and slabs; and joints in work designed to contain liquids. Thoroughly cover with a coat of cement grout of similar proportions to mortar in concrete. Use grout as thick as possible on vertical surfaces and at least 1/2" thick on horizontal surfaces. Place fresh concrete before grout has attained its initial set.

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- D. Prepare joints receiving an adhesive and apply adhesive in accord with manufacturer's recommendations prior to placing of fresh concrete.
- E. Prepare surfaces of joints which have been treated with a chemical retarder in accord with manufacturer's recommendations prior to placing of fresh concrete.

3.07 SLABS - PREPARATION OF SUBGRADE FOR SLABS ON GROUND

- A. Subgrade shall be well drained and of adequate and uniform load bearing nature. Keep in-place density of subgrade soils at least to minimum indicated.
- B. Place vapor barrier over compacted subgrade. See Section 07110-3.01.
- C. Place 2" thick layer of clean mortar sand over vapor barrier per foundation details.
- D. If temperature inside a building where concrete is to be placed is below freezing, raise temperature and maintain above 50 degF long enough to remove all frost from subgrade.

3.08 SLABS - EDGE FORMS AND SCREEDS

- A. Set edge forms and intermediate screed strips accurately to produce designated elevations and contours of finished surface. Unless properly cambered, edge forms and intermediate screeds shall be accurately set high to compensate for deflections of supporting systems due to weight of the fresh concrete. Extra concrete (increased thicknesses) as necessary to produce finished surfaces within specified tolerances at the designated elevations and contours shall be provided at no additional cost to the Owner. Make sufficiently strong to support vibrating screeds or roller pipe screeds, if nature of finish specified requires use of such equipment. Align concrete surfaces to contours of screed strips by use of strike-off templates or approved compacting type screeds.
- B. When formwork is cambered, set screeds to like camber to maintain proper concrete thickness.

3.09 SLAB - PLACEMENT

- A. Carefully coordinate mixing and placing with finishing. Do not place concrete on subgrade or forms more rapidly than it can be spread, straightedged, and darbied or bull floated. Perform these operations before bleeding water has an opportunity to collect on surface.
- B. To obtain good surfaces and avoid cold joints, plan size of finishing crews with due regard to effects of concrete temperature and atmospheric conditions on rate of hardening of concrete. If construction joints become necessary, construct as required under joints and embedded items.

- C. Jointing: Locate joints in slabs on grade as indicated. If saw-cut joints are required or permitted, time the cutting properly with set of concrete: start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw. Complete before shrinkage stresses become sufficient to produce cracking.
- D. Consolidation: Thoroughly consolidate concrete in slabs. Obtain consolidation of slabs with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.

3.10 SLAB FINISHING (SEE SECTION 03350)

3.11 CURING AND PROTECTION

- A. General: Beginning immediately after placement, prevent concrete from premature drying, hot or cold temperatures, and mechanical injury, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration and hardening of concrete. Materials and methods of curing subject to approval.
- B. Preservation of moisture:
 - 1. For concrete surfaces not in contact with forms, apply one of following procedures immediately after completion of placement and finishing:
 - a. Ponding or continuous sprinkling.
 - b. Application of absorptive mats or fabric kept continuously wet.
 - c. Application of sand kept continuously wet.
 - d. Continuous application of mist spray (not exceeding 150 degF).
 - e. Application of sheet curing materials.
 - f. Application of other moisture-retaining covering as approved.
 - g. Application of curing compound. Apply in accord with recommendations of manufacturer immediately after any water sheen which may develop after finishing has disappeared. Do not use on any surface against which additional concrete or other material is to be bonded, or adhesively applied, unless it is proven that curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.

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2. Minimize moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by sun by keeping forms wet until they can be safely removed. After form removal cure concrete until end of time prescribed.
 3. Continue curing concrete for at least 7 days. If tests made of cylinders, kept adjacent to structure and cured by same methods, show average compressive strength has reached 70% of specified strength, (fc'), moisture retention methods may be terminated. If one of curing procedures indicated above is used initially, it may be replaced by one of the other procedures indicated any time after concrete is 1 day old, provided concrete is not permitted to become surface dry during transition.
- C. Temperature, wind, and humidity:
1. Cold weather: When mean daily outdoor temperature is less than 40 degF maintain temperature of concrete between 50 and 70 degF for required curing period. When necessary make arrangements for heating, covering, insulation, or housing concrete work adequate to maintain required temperature without injury. Do not use combustion heaters during first 24 hours unless precautions are taken to prevent exhaust gases which contain carbon dioxide.
 2. Hot weather: When necessary make provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material. Take such protective measures as quickly as concrete hardening and finishing operations will allow.
 3. Rate of temperature change: Keep changes in temperature of air immediately adjacent to concrete during and immediately following curing period as uniform as possible. Do not exceed 5 degF in any 1 hour or 50 degF in any 24 hour period.
- D. Protection from mechanical injury: During curing period, protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. Protect all finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water. Do not load self-supporting structures in such a way as to overstress concrete.
- E. Protection of slabs-on-grade from frost: Interior slabs exposed to freezing temperatures shall be adequately protected so that frost does not develop in the supporting subgrade.

END OF SECTION

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SECTION 03350

CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all concrete finishing and repair of surface defects as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.
5. See Section 03000 for general requirements for concrete work.

1.02 QUALITY ASSURANCE

- A. When finishing is required to match sample furnished to Contractor, make a sample finish on an area at least 4' x 4' in an inconspicuous location designated by Architect before proceeding with finish in specified location.
- B. Finishing tolerances: Horizontal finishes will be accepted provided:
1. Applicable specification requirements are satisfied.
 2. Water does not pond in areas sloped to drain.
 3. Gap between a 10 ft. straight edge placed anywhere and the finished surface do not exceed:

Class A tolerance -----1/8"
Class B tolerance -----1/4"
Class C tolerance -----1/2"
 4. Accumulated deviation from intended true plane of finished surface does not exceed 1/2".

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5. Accuracy of floor finish does not adversely affect installation and operation of movable equipment, floor supported items or items fitted to floor (doors, tracks, etc.).

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 FINISHING - GENERAL (EXCEPT SLABS)

- A. After removal of forms, repair and give surfaces of concrete the finishes indicated.
- B. Unspecified finish: If finish is not designated, use following finishes as applicable:
 1. All unpainted concrete surfaces not exposed to public view: Rough form finish.
 2. All unpainted concrete surfaces exposed to public view: Smooth form finish.
 3. All concrete surfaces to receive paint: Grout cleaned and rubbed finish.
 4. Unformed surfaces (except slabs): As indicated.

3.02 REPAIR OF SURFACE DEFECTS

- A. Repair surface defects immediately after form removal.
- B. Repair defective areas: Remove all honeycombed and other defective concrete down to sound concrete. Chip if necessary to make edges perpendicular to surface or slightly undercut. No feather edges will be permitted. Dampen area to be patched and an area at least 6" wide surrounding it to prevent absorption of water from patching mortar. Prepare a bonding grout of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve. Mix to consistency of thick cream, and then brush into surface.
- C. Make patching mixture of same materials and of approximately same proportions as used for concrete except omit coarse aggregate. Mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume. Mix white and gray portland cement to produce a color matching color of surrounding concrete, as determined by a trial patch. Add no more mixing water than necessary for handling and placing. Mix patching mortar in advance and allow to stand with frequent manipulation, without addition of water, until it has reached stiffest consistency that will permit placing.

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- D. After surface water has evaporated from area to be patched, brush bond coat into surface. When bond coat begins to lose water sheen, apply patching mortar. Thoroughly consolidate mortar into place and strike off so as to leave patch slightly higher than surrounding surface. To permit initial shrinkage, leave undisturbed for at least 1 hr. before final finish. Keep patched area damp for 7 days. Do not use metal tools in finishing a patch which will be exposed.
- E. Fill and finish tie holes: Clean and thoroughly dampen tie holes; fill solid with patching mortar. Round tie holes less than 1/4" diameter x 1-1/2" deep in rough form finished surfaces need not be filled.
- F. Proprietary materials: If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to foregoing patching procedures. Use such compounds in accord with manufacturer's recommendations.

3.03 ROUGH FORM FINISH (ALL CONCEALED SPACES)

- A. Rough form finish: No selected form facing materials are specified for rough form finish surfaces. Patch defects. Chip or ruboff fins exceeding 1/4" in height. Otherwise, leave surfaces with texture imparted by forms.

3.04 SMOOTH FORM FINISH (EXPOSED SURFACES AS NOTED)

- A. Smooth form finish: Use form facing material to produce a smooth, hard, uniform texture on concrete. It may be plastic coated plywood, metal, plastic liners, or other approved material capable of producing desired finish. Arrange facing material orderly and symmetrical, with number of seams kept to practical minimum. Support by studs or other backing capable of preventing excessive deflection. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.
- B. Patch tie holes and defects. Remove all fins completely.
- C. When surface texture is impaired and form joints misaligned by more than 1/8", grind, bushhammer, or correct affected concrete as directed by Architect. Slurry grout areas evidencing minor mortar leakage as a defective area. When in opinion of Architect, workmanship is less than acceptable standard for a smooth form finish, provide one of rubbed finishes indicated at not additional cost to owner.

3.05 RUBBED FINISHES - GENERAL

- A. Produce rubbed finishes on concrete with a smooth form finish. Where smooth rubbed finish is to be applied, remove forms and perform necessary patching as soon after placement as possible without jeopardizing structure.

3.06 RUBBED FINISH - GROUT CLEANED (ALL EXPOSED EXTERIOR SURFACES)

- A. Grout cleaned finish: Undertake no cleaning operations until all contiguous surfaces are completed and accessible. Mix 1 part portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Mix white and gray portland cement to match color of surrounding concrete, as determined by a trial patch. Wet surface of concrete sufficiently to prevent absorption of water from grout and apply grout uniformly. Immediately after applying grout, scrub surface vigorously with a cork float or stone to coat surface and fill all air bubbles and holes. While grout is still plastic, remove all excess grout by working surface with a rubber float, sack, or other means. After surface whitens from drying, rub vigorously with clean burlap. Keep finish damp for at least 36 hrs. after final rubbing.

3.07 FINISHING OF RELATED UNFORMED SURFACES (EXCEPT SLABS)

- A. Strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
- B. Float to a texture reasonably consistent with that of formed surfaces.
- C. Continue final treatment on formed surfaces uniformly across unformed surfaces.

3.08 SLAB FINISHING - GENERAL

- A. Place slabs to tolerances specified and per finish indicated.
- B. Unspecified slab finish: When type of finish is not indicated, use following finish as applicable:
 - 1. Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
 - 2. Surfaces intended to receive waterproofing membranes, or sand bed for tile: floated finish.
 - 3. Floors to receive floor coverings: Troweled finish.
 - 4. Sidewalks, and garage floors: Troweled finish.

3.09 SCRATCHED SLAB FINISH

- A. After concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, roughen surface with stiff brushes or rakes before final set.

3.10 FLOATED SLAB FINISH

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- A. After concrete has been placed, consolidated, struck off, and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operation. During or after first floating check planeness of entire surface with a 10 ' straightedge applied at not less than two different angles. Cut down all high spots and fill all low spots during this procedure to produce a surface within Class B tolerance throughout. Refloat slab immediately to a uniform sandy texture.

3.11 TROWELED SLAB FINISH

- A. First float-finish surface. Next power trowel, and finally hand trowel. First troweling after power floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings by hand after surface has hardened sufficiently. Final trowel when a ringing sound is produced as trowel is moved over surface. Thoroughly consolidate surface by hand troweling. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance. On surfaces intended to receive floor coverings, grind off any defects which would show through floor covering.
- B. Provide troweled slab texture as noted on the Drawings and provide sample for approval of Architect.

3.12 BROOM FINISH

- A. Immediately after concrete has received float finish, give it a coarse transverse scored texture by drawing a broom across surface. Provide sample finish for Architect approval prior to application.
- B. See drawings for locations of broom finishes.

3.13 EXPOSED AGGREGATE FINISHES

- A. Exposed aggregate finishes are achieved by one of the two accepted methods: following the chemical retardation of surface set.
 - 1. Abrasive blasting (commonly known as sandblasting).
 - 2. Chemical retardation of surface set.
- B. Abrasive Blasting
 - 1. This type of finish is classified under the following four headings: brush blast, light abrasive blast, medium exposed aggregate, and heavy exposed aggregate.
 - a. Brush Blast

A brush blast is a little more than a uniform scourcleaning that lightly textures the surface skin of the concrete. Seldom does a particle of coarse aggregate show as a result of this light surface removal. The objective is to remove minor surface variations. To the touch, the surface feels similar to a fine sandpaper.

A brush-blast surface seldom appears uniform at close inspection and should be viewed at a distance for evenness. The concrete mix, like that used with an as-cast surface is to be a uniformly graded mix as the color is largely determined by the cement. However, there is more secondary influence from the fine aggregate in this type of finish. It is sometimes satisfactory to use a concrete pump but only if the mix is not changed to facilitate pumping.

Forming requirements are as stringent as those required for as-cast finishes. Forms must be tight, with a uniform surface that avoids telegraphing surface variations. Form butt joints should not be taped because the imprint of the tape will be important that concrete placement and compaction for this type of finish be done correctly because any segregation or variation in the mix at the concrete surface will be visible. The best placing techniques should be used.

Brush blasting can be done at almost any time after seven days of the concrete casting. Although some projects have been successfully brush blasted at the end of construction it has ordinarily been advantageous to set up a schedule of time limits so that the constructor knows how much variation in timing is safe without affecting the uniformity of the surface.

b. Light Abrasive Blasting

Light abrasive blasting removes the surface skin sufficiently to expose the coarse particles of the fine aggregate as well as a few particles of the coarse aggregate. The surface is flat with little texture. After exposure, the fine aggregate exerts the primary effect on the color of the surface and the effect of both the cement and coarse aggregate are secondary. Conventional mix design methods can be used, except that at least ten percent more coarse aggregate is recommended. Slumps should be three inches plus or minus one-half inch. Tight, impervious forms should be used, although slight surface deformations like those occurring after sealing of joints with tape will usually be blasted away. Although blasting can be done at almost any time for this

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type of finish, a delay of seven or more days after casting is recommended. Blasting prior to 45 days is also recommended.

c. Medium Exposed Aggregate

Medium abrasive blasting exposes the coarse aggregate to the extent that it projects from the mortar of the concrete. The coarse aggregate is required to be uniformly distributed over the surface to produce an acceptable result. The concrete mix should be designed with a higher than normal coarse aggregate factor to minimize the probability of uneven distribution. While a concrete sand gradation can usually be used, it is advantageous in some cases to use a masonry or industrial sand for the fine aggregate where most of the particles pass a Number 8 sieve. Slump should not exceed three inches, and two inches is often desirable. The coarse aggregate should be a hard material, because soft aggregate might be eroded at the same rate as the mortar during abrasive quality and materials. Although forms with a high reuse factor such as steel, fiberglass-reinforced plastic and high-density plywood are usually preferable, good results have been achieved using a B-B plywood form, not oiled, with a good two-coat application of form sealer. Taping or rubberized caulking and gasketing of plywood butt joints has produced successful forming results with this type of finish. Abrasive blasting should be done prior to seven days after casting.

d. Heavy Exposed Aggregate

Heavy exposed aggregate finishing erodes the surface to the extent that the coarse aggregate projects out considerably from the matrix. Approximately 80 percent of the visible surface should be coarse aggregate. A normal concrete mix even with a slightly higher coarse aggregate factor is not acceptable. In this type of finish, a lack of uniform aggregate distribution and any significant separation between coarse aggregate particles is highly undesirable architecturally. Therefore, a special mix design with a high coarse aggregate factor is essential. Gap grading is usually desirable and a careful gradation of both coarse and fine aggregate is important.

Methods that utilize dry preplacement of coarse aggregate followed by in-place grouting can be used for finishes that require larger graded materials such as 3/4 inch to 1-1/2 inch maximum size graded coarse aggregate and larger. They are not appropriate for smaller coarse aggregate sizes.

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For coarse aggregate gradations of less than one inch maximum size, gap grading is most appropriate. Gap-graded mixes with coarse aggregate larger than one inch maximum are extremely difficult to place because the larger particles seldom move from their original position even with heavy vibrator effort, and they are more prone to segregate in the mixer truck. The gap-graded mix is frequently a zero-slump concrete and is seldom used at slumps higher than two inches. The mix must be deposited by bottom drop buckets with steep slopes on both sides. High frequency type vibration equipment is essential to properly place and consolidate the lifts of concrete. Although the quality of the form does not have to be equal to that indicated for the lighter blasted surfaces, the form surface should not absorb moisture, nor should the joints permit leakage as these changes will cause hard, dark areas on the concrete. Release agent discoloration can be removed by increasing the blasting intensity or degree. Vertical form faces should be removed within 24 hours after casting and the concrete immediately abrasive blasted.

2. Provide 4' x 4' sample of finishes specified on drawings for Architect's review and approval prior to proceeding with final blasting.

C. Chemical Retardation of Surface Set

Surface retarders applied to forms or directly to slabs react to delay the surface skin of the concrete from setting normally.

1. Composition and Materials

An approved retarder is a coating which, when applied directly to the concrete surface immediately after finishing, or directly to the forms prior to pouring, delays but does not prevent final hardening of the surface. It requires care and attention to produce an excellent job. The depth of the retarded-set concrete surface will be approximately 3/16" with minor variations caused by differences in troweling, retarded coverage, time interval before revealing, or temperature. The retarder contains a dye which aids in the removal of the specified depth of surface material for aggregate exposure.

2. Manufacturers

"Lithotex Top Surface Retarder" as manufactured by L.M. Scofield; "Heat-Cote Blue or Yellow" as manufactured by Preco Industries (800-645-1237); or acceptable alternate.

3. Concrete Mix Design (Submit mix design for review)

An extremely coarse mix containing the greatest possible percentage of the selected coarse aggregate and a minimum amount of mixing water should be used in the concrete being placed. Water-reducing and air-entraining admixtures may be used, but not calcium chloride nor other accelerants.

4. Preparatory Work

The concrete should be placed and consolidated so as to fill completely all spaces in the forms. Tamping is not permitted because the coarse aggregate must remain near the surface for later exposure. Either a wood float or steel trowel finish should be applied, depending on the depth of aggregate exposure desired, the former permitting about 3/16" and the latter, 1/8".

5. Application

For horizontal slab surfaces, as soon as final floating or troweling has been completed, the retarder is thoroughly mixed and strained and then sprayed evenly over the surface full strength with a Hudson-type sprayer. If overspray on adjacent work must be avoided, a brush or roller may be used. If a continually high temperature is expected or a deep reveal is desired, the surface may be covered with plastic sheeting or curing paper until the retarder is removed. For vertical surfaces, apply the retarder evenly over the inside surfaces of all forms, being sure to follow the manufacturer's specifications for application.

6. Aggregate Reveal and Curing

The retarder must be removed between 8 and 20 hours after placement with a coarse-fibered or rust-resistant-wire scrub brush and jet of water. If the concrete is colored or when a clear sealer is to be used, the surface should be covered after aggregate reveal with new, nonstaining, curing paper. For other exposed-aggregate concrete, either water or a liquid membrane-type curing compound may also be used.

7. Surface Sealing

If efflorescence or alkali-staining is evident after the concrete has cured and a clear sealer is to be applied, exposed-aggregate surfaces should be lightly washed with a mild muratic acid solution (usually a 10:1 dilution), thoroughly rinsed with water, cleaned with a diluted approved Floor Cleaner, rinsed again and dried thoroughly. Two coats of an approved Clear Sealer are then applied to the thoroughly dry surface in accordance with the manufacturer's specifications.

8. Samples

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Provide 4' x 4' sample panel of specified aggregate finish for Architect's review and approval.

3.14 COLORED CONCRETE

- A. Integrally colored concrete shall contain color admixture as provided by "Davis Colors" or "L.M. Scofield", in strict accord with manufacturer's recommendations. Color, as indicated on plans.

3.15 SLAB HARDENER

- A. Apply chemical hardener floor treatment after finishing operation to all interior floor slabs which are exposed in finished work and elsewhere as indicated.
- B. Apply chemical hardener in accord with manufacturer's printed instructions, and after complete curing and drying of concrete surface. After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.
- C. Chemical hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. fluosilicate per gallon. Provide materials which do not react with, inhibit, or otherwise interfere with adhesives and bonding of future floor finishes. Approved products and manufacturers are as follows:
 - "Chem-Hard" by L & M Construction Chemicals
 - "Saniseal" by Master Builders Co.
 - "Lapidolith" by Sonneborn-Contech
 - "Lithoplate" by Protex Industries
- D. Do not place liquid floor hardener on floor areas scheduled to receive synthetic matrix terrazzo, or setting beds for tile, terrazzo and like items.

3.16 REPAIR OF REJECTED HORIZONTAL FINISHES

- A. Unacceptable horizontal finishes shall be replaced or corrected provided strength and appearance are not adversely affected. High spots may be removed by grinding and/or low spots filled with a patching compound or other remedial measures performed or permitted.

END OF SECTION

**DIVISION 4
MASONRY**

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SECTION 04050

COLD AND HOT WEATHER PROTECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for cold and/or hot weather protection as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Related work specified elsewhere:

1. Cold-weather protection for concrete: Division 3.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL

- A. Do not use frozen or ice coated materials.
- B. At end of each day or at shutdown, cover tops of all walls not enclosed or sheltered. Protect in accord with this section and requirements of other sections on masonry construction.
- C. Remove and replace frozen or damaged masonry to satisfaction of Architect.

3.02 TEMPORARY FACILITIES

- A. Construct and maintain temporary protection required to permit continuous and orderly progress of work.
- B. Provide and maintain heat sufficient to assure temperature above 32 degF within protected areas.

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- C. Provide temporary lighting at levels to permit work to be correctly performed.

3.03 PROCEDURES - COLD WEATHER PROTECTION

- A. Air temperatures: 32 to 40 degF:
 - 1. Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 degF.
- B. Air temperature: 25 to 32 degF :
 - 1. Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 degF.
 - 2. Maintain mortar temperatures above freezing.
- C. Air temperature: 20 to 25 degF :
 - 1. Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 degF.
 - 2. Maintain mortar temperatures above freezing, until used.
 - 3. Provide heat on both sides of walls under construction.
 - 4. Provide windbreaks or shelters when wind is in excess of 15 MPH.
- D. Air temperature: Below 20 degF:
 - 1. Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 degF.
 - 2. Maintain mortar temperatures above freezing, until used.
 - 3. Maintain temperature of units until laid at not less than 25 degF.
 - 4. Maintain air temperature on each side of wall above freezing.
- E. Air temperature after installation: 32 to 40 degF :
 - 1. Protect from rain or snow for not less than 24 hours by covering with weather-resistive membrane.
- F. Air temperature after installation: 25 to 32 degF :
 - 1. Completely cover with weather-resistive membrane for not less than 24 hours.

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- G. Air temperature after installation: 20 to 25 degF:
 - 1. Completely protect with insulating blankets for not less than 24 hours or provide other protection approved by Architect.
- H. Air temperature after installation: Below 20 degF:
 - 1. Maintain above 32 degF for 24 hours.
 - 2. Do not allow rapid drop in temperature after removal of heat.

3.04 PROCEDURES - HOT WEATHER PROTECTION

- A. If temperature of water or aggregate exceeds 100 degF combine water with aggregate in mixer before cement is added. Do not mix cement with water or with mixtures of water and aggregate having a temperature exceeding 100 degF.

Hot Weather: Cool ingredients before mixing, or add flake ice or well-crushed ice of a size that will melt completely during mixing for all or part of mixing water.

- 1. Store sand, masonry units, and mixing equipment in shaded areas.
- 2. Make certain that sand is moist. Sprinkle sand pile if needed to maintain moisture.
- 3. Dampen high absorption brick.
- 4. Dampen mortar boards and cover mortar boxes.
- 5. Construct wind breaks protecting construction areas.
- 6. Self secure masonry wall by covering with plastic at the end of the day, or fog mortar joints after they achieve initial set to compensate for evaporation.

END OF SECTION

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SECTION 04100

MORTAR AND MASONRY GROUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all mortar and masonry grout for all masonry construction as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all others trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 QUALITY ASSURANCE

A. Materials standards: ASTM and CBC Standards indicated.

B. Mortar testing:

1. As required in Section 01400 - General Testing Procedures
2. Tests of field mixed mortar shall also conform to CBC Standard 24-22.
3. Retest when initial test fails.

C. Grout testing:

1. As required in Section 01400 - General Testing Procedures.
2. Perform all tests specified in ASTM C476.
3. Tests of field mixed grout shall also conform to CBC Standard 24-22.
4. Retest when initial test fails.

1.03 SUBMITTALS (SEE SECTION 01340)

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- A. Design mix reports for each type of mortar and grout used. Include description of contents and proportions, and results of tests specified in paragraph "Quality Assurance". See Section 01400 - General Testing Procedures.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Portland cement: ASTM C150, Type I.
 - 1. No air entrainment.
 - 2. Natural gray color when used with all unexposed masonry units.
 - 3. Colored mortar shall be used as noted on the drawings.
 - 4. Maximum percent of alkalis: 0.60 in accord with Table 1A.
- B. Hydrated lime: ASTM C207, Type S.
- C. Mortar aggregate: ASTM C144.
- D. Grout: ASTM C476.
- E. Water: Potable.

2.02 MIXES

- A. Mortar mix:
 - 1. Proportions: 1 part portland cement, 1/4 part to 1/2 part lime, and 3-1/2 to 4 parts sand by volume.
 - 2. Minimum compressible strength: 1800 PS I.
 - 3. Do not use masonry cement.
 - 4. Mix materials minimum of 3 minutes.
 - 5. Adjust consistency to satisfaction of mason.
 - 6. Use no anti-freeze additives.
 - 7. Mortar colors shall match color of integral colored concrete block. Colors shall be "Davis" mortar colors or acceptable substitution.
- B. Grout mixes: Comply with ASTM C476, Table 2.

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1. Use no anti-freeze additives.
2. Mix materials minimum of 5 minutes.
3. Minimum compressive strength: 2000 PSI.
4. When using a "grout pump" to convey grout, use mix which contains plasticizer to aid in movement.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with requirements specified for materials being set or grouted.
- B. If mortar begins to stiffen within 2-1/2 hours, it may be retempered by adding water and remixing.
- C. Do not use mortar after it has begun to set.
- D. Use grout within 2 hours after initial mixing. Use no grout after it has begun to set.
- E. Use coarse grout in spaces with least dimension over 2".

END OF SECTION

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SECTION 04220

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment, and services for all concrete unit masonry construction as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Related work specified elsewhere:

1. Mortar and Masonry Grout: Section 04100.
2. Masonry cleaning: section 04510.
3. Design criteria: CBC, latest adopted edition.

1.02 QUALITY ASSURANCE

A. Tolerances:

1. From plumb, in lines and surfaces of columns, walls and arises:
 - a. In 10 ft.: 1 in 100.
 - b. In 40 ft. or more: 1 in 800.
2. From plumb, for external corners, control joints and other conspicuous lines:
 - a. In any story or 20 ft. maximum: 1 in 200.
 - b. In 40 ft. or more: 1 in 800.

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3. From level or grades:
 - a. In any bay or 20 ft. maximum: 1 in 200
 - b. In 40 ft. or more: 1 in 800
4. Linear building lines from established position in plan and related portion of columns, walls, and partitions:
 - a. In any bay or 20 ft. maximum: 1 in 100.
 - b. In 40 ft. or more: 1 in 600.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.
- B. Protect all materials from elements.

1.04 JOB CONDITIONS

- A. Protect against weather, when work is not in progress.
- B. Cover top of walls with waterproof membrane, extend at least 4 ft. down both sides of walls and anchor in place.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete masonry units: (Unexposed concrete block) - Modular block units, standard grey color, ASTM C90, latest edition, Grade N, Type I, and C145, and CBC Standard 24-4, Grade N.
 1. Sizes and shapes as indicated or required for conditions.
 2. Face shell and web thickness: Table 3.
 3. Moisture content: Table 1.
 4. Fire resistive units: U/L rated.
 5. Provide concrete blocks of same materials, texture and quality.
 6. Do not use chipped, cracked, spalled, or imperfect units.
- B. Horizontal joint reinforcing: See Section 03200, and drawings.

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- C. Vertical reinforcing bars: As indicated on drawings and specified in Section 03200.
- D. Mortar: See Section 04100.
- E. Sealants: As specified in Section 07900.

PART 3 - EXECUTION

3.01 PREPARATION PRIOR TO INSTALLATION

- A. Verify suitability of substrate to accept work.
- B. Verify that anchors and flashings are correct.
- C. Installation constitutes acceptance of substrate and responsibility for performance.

3.02 INSTALLATION - GENERAL

- A. Build walls to thickness indicated.
- B. Build in flashing, reinforcing, weeps and related items.
- C. Perform all cutting with masonry saws.
- D. Cut as required to provide pattern indicated.
- E. Install in running bond, unless otherwise noted on drawings.
- F. Avoid use of less than half size units, except to form radii.
- G. Do not install damaged units.

3.03 LAYING AND TOOLING

- A. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints. Properly locate openings, movement type joints, returns and offsets.
- B. Lay masonry units with completely filled bed and head joints.
 - 1. Butter ends with sufficient mortar to fill head joints and shove into place.
 - 2. Do not slush head joints.
- C. Maintain nominal 3/8" joint widths.

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1. Masonry walls to receive plaster.
 - a. Do not tool joints. Rub all joints flush with surface of block units in order to receive plaster coat.
 2. Masonry walls exposed to be painted.
 - a. Tool all joints in a concave pattern.
 3. Masonry walls with integral colored masonry units.
 - a. Precision masonry units.
 - 1) Tool all joints in a concave pattern.
 - b. Split-faced masonry units.
 - 1) Do not tool joints. Rub all joints flush with surface.
- D. During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar.
- E. Point-up all joints at corners, openings and adjacent work to provide neat, uniform appearance.
- F. Remove masonry disturbed after laying.
 1. Clean and re-lay in fresh mortar.
 2. Do not pound units to fit.
 3. If adjustments are required, remove units, clean, and reset in fresh mortar.
- G. Where work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
 1. Remove loose units and mortar prior to laying fresh masonry.
- H. As work progresses, build-in items indicated and specified.
 1. Fill in solidly with mortar around built-in items.
 2. Grout-fill space between metal frames and masonry.

3.04 REINFORCING AND FILLING

- A. Fill all cells with grout: consolidate grout by puddling or mechanical vibrations.

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- B. Where vertical reinforcing is required, place and inspect it prior to filling operation.
- C. Place in maximum 4 ft. lifts.
- D. Leave lifts minimum 1-1/2", maximum 2" below top of course to form key with next lift.
- E. Reinforce masonry openings same as for concrete openings.
- F. At intersecting load-bearing walls provide rigid steel anchors 24" on center vertically, embed ends in grout filled cells.

3.05 CONTROL JOINTS AND SEALANTS

- A. Provide vertical expansions, control and isolation joints where indicated.
 - 1. Where not indicated, provide at maximum 30 ft. on center.
 - 2. Rake out all mortar.
 - 3. Locate control joints at points of natural weakness in masonry.
- B. See Section 07900 for sealant installation requirements.
 - 1. Seal joints between concrete masonry unit and metal frames or other dissimilar materials.
 - 2. Seal expansion and control joints.

3.06 REPAIR, POINTING, AND CLEANING

- A. Remove and replace loose, stained, or damaged units.
 - 1. Provide new units to match.
 - 2. Install in fresh mortar.
 - 3. Point to eliminate evidence of replacement.
- B. Clean in accord with Section 04510.

END OF SECTION