

VA Palo Alto Defenders Lodge Entry and Service Yard Upgrade

Bid Document Specifications

VA Palo Alto Health Care System

3801 Miranda Avenue Palo Alto, California

DVA Project No.640-14-127

December 24, 2015



TABLE OF CONTENTS
SECTION 00 01 00

DIVISION 00 – SPECIAL SECTIONS

00 01 15	List of Drawing Sheets	2
----------	------------------------	---

DIVISION 01 – GENERAL REQUIREMENTS

01 00 00	General Requirements	14
01 32 16	Project Schedules	7
01 33 23	Shop Drawings, Product Data, and Samples	4
	Material Approval Submittal Form	1
01 35 26	Safety Requirements	19
01 42 19	Reference Standards	8
01 45 29	Testing Laboratory Services	8
01 57 19	Temporary Environmental Controls	4
01 74 19	Construction Waste Management	5

DIVISION 02 – EXISTING CONDITIONS

02 41 00	Demolition	3
----------	------------	---

DIVISION 03 – CONCRETE

03 30 00	Cast-In-Place Concrete	15
----------	------------------------	----

DIVISION 04 – MASONRY

04 05 13	Masonry Mortaring	4
04 05 16	Masonry Grouting	4
04 20 00	Unit Masonry	12
04 72 10	Stone Veneer Wall	6

DIVISION 05 – METALS

05 12 00	Structural Steel Framing	5
05 50 00	Metal Fabrications	7
05 58 13	Formed Metal Column Covers	6

DIVISION 06 – WOOD AND PLASTIC

06 10 00	Rough Carpentry	5
----------	-----------------	---

DIVISION 07 – THERMAL AND MOISTURE PROECTION

07 60 00	Flashing and Sheet Metal	7
07 92 00	Joint Sealants	7

DIVISION 08 – DOORS AND WINDOWS

08 44 23	Glazing Support Systems	5
08 80 00	Glazing	6

DIVISION 09 – FINISHES

09 06 00	Schedule for Finishes	5
09 22 16	Non-Structural Metal Framing	3
09 29 00	Gypsum Wallboard	5
09 65 13	Resilient Base and Accessories	4
09 91 00	Painting	12

DIVISION 10 – SPECIALTIES

10 26 00	Wall Protection	3
----------	-----------------	---

DIVISION 11 – EQUIPMENT

Not Used

DIVISION 12 – FURNISHINGS

12 32 00	Manufactured Wood Casework	6
----------	----------------------------	---

DIVISION 13 – SPECIAL CONSTRUCTION

13 05 41	Seismic Restraint Requirements for Non-Structural Components	7
----------	--	---

DIVISION 14 – CONVEYING SYSTEMS

Not Used

DIVISION 21 – FIRE SUPPRESSION

Not Used

DIVISION 22 – PLUMBING

Not Used

DIVISION 23 – HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

Not Used

DIVISION 26 – ELECTRICAL

26 05 11	Requirements for Electrical Installations	9
26 05 19	Low-Voltage Electrical Power Conductors and Cables	8
26 05 26	Grounding and Bonding for Electrical Systems	7
26 05 33	Raceway and Boxes for Electrical Systems	9
26 05 41	Underground Electrical Construction	8
26 09 23	Lighting Controls	6
26 56 00	Exterior Lighting	5

DIVISION 27 – COMMUNICATIONS

Not Used

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Not Used

DIVISION 31 – EARTHWORK

31 20 00	Earthwork	13
31 23 23.33	Flowable Fill	5
31 63 26	Drilled Caissons	11

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 05 20	Cement and Concrete for Landscaping Exterior Improvements	10
32 05 23	Cement and Concrete for Exterior Improvements	11
32 12 16	Asphalt Paving	4
32 14 13	Concrete Pavers	5
32 17 23	Pavement Markings	3
32 84 00	Planting Irrigation	19
32 90 00	Planting	18

DIVISION 33 – UTILITIES

33 40 00	Storm Sewer Utilities	8
----------	-----------------------	---

--- E N D ---

SECTION 00 01 15
LIST OF DRAWING SHEETS

The drawings listed below accompanying this specification form a part of the contract.

<u>DRAWING NO.</u>	<u>TITLE</u>
GENERAL	
G0-1	Cover Sheet
G0-2	Project Team, Project Data, Abbreviations, Symbols, Materials, and Drawing Index
G0-3	Existing First Floor Existing Plan (For Reference Only)
G0-4	Existing Second Floor Existing Plan (For Reference Only)
CIVIL	
CS 100	General Notes
CS 201	Demolition Plan
CS 300	Horizontal Control Plan
CS 301	Layout Plan
CS 302	Layout Plan
CS 401	Grading Plan
CS 501	Utility Plan
CS 801	Details
CS 802	Details
LANDSCAPE	
L1.0	Landscape Construction Plan
L2.0	Landscape Construction Details
L2.1	Landscape Construction Details
L3.0	Irrigation Plan
L4.0	Irrigation Details
L5.0	Planting Plan
L6.0	Planting Details

ARCHITECTURAL

AS0-1	Site Plan
AS0-2	Enlarged Service Yard Demolition and Floor Plans, and Elevation
AS1-1	Partial First Floor and Second Floor Demolition Plans
AS4-1	Partial First Floor Plan and Interior Elevation
AS7-1	Enlarged First Floor and Second Floor Stair Plans
AS7-2	Stair Elevations and Balcony Elevations
AS7-3	Glass Guardrail and Barrier Details
AS8-1	Canopy Floor Plan and Roof Plan – Loop Road Side
AS8-1A	Canopy Floor Plans and Roof Plan – Miranda Avenue Side
AS8-1B	Canopy Section and Details
AS9-1	Exterior and Interior Details, and Casework Schedule and Details

STRUCTURAL

SS0-1	General Notes
SS0-2	Abbreviations and Symbols
SS0-3	Defenders Lodge Canopy Foundation and Roof Framing Plan
SS0-4	Elevations
SS0-5	Steel Details
SS0-6	Enlarged Service Yard Plans
SS0-7	Lobby Stair – Enlarged Proposed Plan and Elevation

ELECTRICAL

ES0.01	Symbol Legend, Details, Abbreviations, General Notes and Schedule
ES0.02	Site Plan - Electrical

--- E N D ---

**SECTION 01 00 00
GENERAL REQUIREMENTS
TABLE OF CONTENTS**

1.01	SAFETY REQUIREMENTS.....	1
1.02	GENERAL INTENTION	1
1.03	STATEMENT OF BID ITEM(S)	2
1.04	SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR.....	2
1.05	CONSTRUCTION SECURITY REQUIREMENTS	2
1.06	OPERATIONS AND STORAGE AREAS.....	3
1.07	ALTERATIONS.....	6
1.08	INFECTION PREVENTION MEASURES.....	6
1.09	DISPOSAL AND RETENTION	7
1.10	PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS.....	7
1.11	RESTORATION.....	8
1.12	LAYOUT OF WORK	8
1.13	AS-BUILT DRAWINGS.....	9
1.14	USE OF ROADWAYS	9
1.15	TEMPORARY USE OF EXISTING ELEVATORS.....	9
1.16	TEMPORARY TOILETS.....	10
1.17	AVAILABILITY AND USE OF UTILITY SERVICES	10
1.18	GOVERNMENT-FURNISHED PROPERTY.....	11
1.19	RELOCATED EQUIPMENT AND ITEMS.....	12
1.20	CONSTRUCTION SIGN.....	12
1.21	SAFETY SIGN.....	12
1.22	PHOTOGRAPHIC DOCUMENTATION.....	13
1.23	HISTORIC PRESERVATION	13

**SECTION 01 00 00
GENERAL REQUIREMENTS**

1.01 SAFETY REQUIREMENTS

- A. Refer to section 01 35 26, SAFETY REQUIREMENTS for safety and infection control requirements.

1.02 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, landscape and hardscape, site improvement, etc. and furnish labor and materials and perform the construction / renovation work for the renovation of the Defender's Lodge Entry and Service Yard Project for the VA Palo Alto Health Care System as required by drawings and specifications. The Project is located in Palo Alto, California. A brief description of project scope and its locations as follows:
 - 1. Exterior Work: Provide glass canopy structures at both entrances of the Defender's Lodge; reconfigure service yard enclosure to clear the SF/PUC Right-of-Way; provide new outdoor seating patio at area between the Defender's Lodge and existing Fisher House; and perform all exterior improvement work as shown on Drawings.
 - 2. Interior Work: Provide new glass guardrail and glass barrier system at existing main lobby Grand Stairs and balcony on Second Floor of the Defender's Lodge; provide wall protection at existing columns furring as shown; remove and replace cabinets in existing Public Kitchen on First Floor of the Defender's Lodge, and perform all interior work as shown on Drawings.
- B. Visits to the site by Bidders may be made only by appointment with the Contracting Officer or his duly authorized representative.
- C. Offices of MEI Architects, 239 9th Street, Suite 201, San Francisco, California 941013, as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.
- D. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.
- E. The Contracting Officer's Representative will assign specific routes and times for pathways, corridors and elevators for transportation of personnel, materials and equipment. The Contractor will continually clean-up any dust, dirt or debris caused by their jobsite ingress/egress.
- F. Dust and fume control will be exercised during all construction operations. Workers will be careful not to operate any vehicles, gas or diesel engines, or to perform any fume or dust generating process near a building air intake system. Noise will be held to a minimum at all times. Jack-hammering, core drilling and other noisy or disturbing operations may have to be rescheduled or accomplished after hours to avoid interfering with surgery or patient care services

1.03 STATEMENT OF BID ITEM(S)

- A. ITEM I, BASE BID, GENERAL CONSTRUCTION: Work includes general construction, alterations, roads, walks, grading, drainage, site work, architectural work and finishes, structural, electrical, utility systems, landscape, necessary removal of existing structures and construction and certain other items as shown on the Drawings and Specifications.

1.04 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. After award of contract, specifications and drawings will be available for download from a link provided by the Contracting Officer's Representative.

1.05 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:
1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
 2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.
- B. Security Procedures:
1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.
 2. The Contractor shall create an Employee Daily Log of all personnel working on the site. The Employee Daily Log shall contain the employee's (a) Full Name, (b) Employer/Company Name and (c) Occupation/Trade. The Employee Daily Log shall be submitted with the Contractor's Daily Work Report.
 3. All work on the contract shall be performed between 7:00 am and 5:00 pm Monday through Friday, excluding National Holidays, unless approved in writing by the Contracting Officer. For working outside these hours, the Contractor shall give two weeks' notice to the Contracting Officer's Representative so that oversight, security and escort arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this specification.
 4. No photography of VA premises is allowed without written permission of the VA Public Affairs Officer. Submit request to the Contracting Officer's Representative.
 5. The VA Police are Federal Police Officers with full authority to make arrests, investigate crimes and issue traffic citations. Citations issued require an appearance in the Federal District Court and/or payment of a fine. Speed limits and other driving and parking codes are strictly enforced. Any vehicle left unattended for more than a few minutes may be cited by the VA Police.
 6. Sexual harassment is strictly prohibited. This includes deliberate or unsolicited verbal comments or gestures of a sexual nature, unwelcome sexual advances, requests for sexual favors and/or other unwelcome verbal or physical conduct of a sexual nature.
 7. Possession or use of non-prescription drugs or alcohol, including beer and wine, on the Health Care System grounds is strictly prohibited. Possession of firearms, knives with blades over 4-inch, ammunition, explosive devices and any item that may be considered an offensive weapon is strictly prohibited. This includes carrying such items in vehicles.
 8. The Health Care System does not have the equipment, facilities, or personnel trained to handle serious injuries. Call 911 for emergency medical assistance and notify the Contracting Officer's Representative and the VA Police.

9. Vehicle authorization requests shall be required for any vehicle entering the site and such requests shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies. Separate permits shall be issued for Contractor and subcontractor employees for parking in designated areas only.
 10. VA reserves the right to shut down the project site and order Contractor's employees and subcontractors off the premises in the event of a national emergency or local disaster. The Contractor may return to the site only with the written approval of the Contracting Officer's Representative.
- C. Key Control:
1. The Contractor shall provide duplicate keys and lock combinations to the Contracting Officer's Representative for the purpose of security inspections and emergency actions for every area of the project site including tool boxes and parked machines.
 2. The Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation.
- D. Document Control:
1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
 2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
 3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.
 4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
 5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
 6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
 7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
 - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

1.06 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer's Representative. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer's Representative and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at their expense upon completion of the work. With the written consent of the Contracting Officer's Representative, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, as prescribed by the Contracting Officer's Representative, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer's Representative. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law, code or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- D. Working space and space available for storing materials shall be as determined by the Contracting Officer's Representative.
- E. Workmen are subject to rules of the VA Campus applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole and specifically with operations of the Defenders Lodge and Fisher House, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.
 - 1. Do not store materials and equipment in other than assigned areas.
 - 2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.
- G. The Defender's Lodge and the adjacent buildings, including but not limited to, Fisher House, Building 50, etc., will be occupied during performance of work.
 - 1. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Centers operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. These routes whether access or egress shall be isolated from the construction area by temporary partitions and have walking surfaces, lighting, etc. to facilitate patient and staff access. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.
- H. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area as indicated on the Drawings. Relocate construction fence as directed by COR. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and

top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by COR.

- I. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.
 1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of Contracting Officer's Representative. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Contracting Officer's Representative prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS for additional requirements.
 2. Contractor shall submit a request to interrupt any such services or systems to Contracting Officer's Representative, in writing, six (6) weeks in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption. Approved outage dates are not guaranteed and are subject to VA operational requirements.
 3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the VA. Interruption time approved by Contracting Officer's Representative may occur at other than Contractor's normal working hours.
 4. In case of a contract construction emergency, service will be interrupted on approval of Contracting Officer's Representative. Such approval will be confirmed in writing as soon as practical.
 5. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service connection to the construction project, for such items as water, sewer, electricity or gas, payment of such fee shall be paid by the Contractor unless specifically relieved in writing by the Government.
- J. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- K. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
 1. The Contractor shall not block any road or street, walkway or building egress without requesting approval from the Contracting Officer's Representative. Submit written request one (1) week prior to proposed blockage. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new work crosses existing roads, at least one lane must be open to traffic at all times.
 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Contracting Officer's Representative.

- L. Coordinate this contract with other construction operations as directed by Contracting Officer's Representative. This includes the scheduling of traffic and the use of roadways.

1.07 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, to the Contracting Officer. This report shall list by rooms and spaces:
 - 1. Existing condition and types of flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of buildings.
 - 2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by drawings to be either reused or relocated, or both.
 - 3. Shall note any discrepancies between drawings and existing conditions at site.
 - 4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
 - 1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.
- D. Protection: Provide the following protective measures:
 - 1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
 - 2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
 - 3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.08 INFECTION PREVENTION MEASURES

- A. Refer to SECTION 01 35 26 SAFETY REQUIREMENTS, Article 1.12.

1.09 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
1. Reserved items which are to remain property of the Government are identified by attached tags or noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
 2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.
 3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.
 4. The Contractor is required to alert the VA immediately in the event any known or suspected hazardous materials are disturbed or will need to be disturbed before proceeding with work. Hazardous materials, such as PCB's, asbestos, lead paint, cleaning solutions and other harmful chemicals shall be disposed of in accordance with federal, state and local laws and regulations. In case of an accidental spill of hazardous materials, the Contractor shall take immediate action to contain the spill and notify the Contracting Officer's Representative. Washing cement, plaster, paint, oil or grease, solvents, etc. into any drains is strictly prohibited. REPORT ANY ACCIDENTAL SPILLS THAT MAY RUN INTO STORM DRAINS IMMEDIATELY TO ENGINEERING SERVICE AT EXTENSION 62468.
 5. Contractor shall provide a monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling per SECTION 01 74 19 CONSTRUCTION WASTE MANAGEMENT.

1.10 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

- A. The Contractor shall preserve and protect all structures, equipment and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer's Representative.
- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer's Representative may have the necessary work performed and charge the cost to the Contractor.

1.11 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone, computer network, etc.) which are indicated on drawings or reasonably discovered during execution of the work and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings for which locations are unknown and not reasonably discovered will be considered for adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 LAYOUT OF WORK

- A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all templates, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer's Representative. The Contractor shall also be responsible for maintaining and preserving all stakes and marks established by the Contracting Officer's Representative until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer's Representative may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor. (FAR 52.236-17)
- B. Establish and plainly mark center lines for each building, and corner of column lines and addition to each existing building, and such lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings,

exterior walls, major utilities and elevations of floor slabs.

1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, utilities and other major controlling features) is placed.
- D. During progress of work, Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COR before any major items of concrete work are placed. In addition, Contractor shall also furnish to the COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
1. Lines of each building.
 2. Elevations of bottoms of footings.
 3. Lines and elevations of sewers and of all outside distribution systems.
 4. Lines and elevations of all swales and interment areas.
 5. Lines and elevations of roads, streets and parking lots.
- E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to COR.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.13 AS-BUILT DRAWINGS

- A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COR review, as often as requested.
- C. Contractor shall deliver two approved completed sets of as-built drawings to the COR within fifteen (15) calendar days after each completed phase and after the acceptance of the project by the COR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.14 USE OF ROADWAYS

- A. For hauling, use only established public roads and roads on the VA Campus and, when authorized by the Contracting Officer's Representative, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed transitions.

1.15 TEMPORARY USE OF EXISTING ELEVATORS

- A. Use of existing elevator for handling building materials and Contractor's personnel will be permitted subject to following provisions:

1. Contractor makes all arrangements with the COR for use of elevators. The COR will ascertain that elevators are in proper condition. Contractor may use elevators for special nonrecurring time intervals when permission is granted. Personnel for operating elevators will not be provided by the Department of Veterans Affairs.
2. Contractor covers and provides maximum protection of following elevator components:
 - a. Entrance jambs, heads soffits and threshold plates.
 - b. Entrance columns, canopy, return panels and inside surfaces of car enclosure walls.
 - c. Finish flooring.
3. Government will accept hoisting ropes of elevator and rope of each speed governor if they are worn under normal operation. However, if these ropes are damaged by action of foreign matter such as sand, lime, grit, stones, etc., during temporary use, they shall be removed and replaced by new hoisting ropes at the Contractor's expense.
4. If brake lining of elevators are excessively worn or damaged during temporary use, they shall be removed and replaced with new brake lining.
5. All parts of main controller, starter, relay panel, selector, etc., worn or damaged during temporary use shall be removed and replaced with new parts, if recommended by elevator inspector after elevator is released by Contractor.
6. Place elevator in condition equal, less normal wear, to that existing at time it was placed in service of Contractor as approved by Contracting Officer's Representative.

1.16 TEMPORARY TOILETS

- A. Contractor may have for use of Contractor's workmen, such toilet accommodations as may be assigned to Contractor by Medical Center. Contractor shall keep such places clean and be responsible for any damage done thereto by Contractor's workmen. Failure to maintain satisfactory condition in toilets will deprive Contractor of the privilege to use such toilets.

1.17 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner, in compliance with code and as satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia and repair restore the infrastructure as required.
- C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

1. Obtain heat by connecting to Medical Center heating distribution system.
 2. Steam is available at no cost to Contractor.
- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.
- F. Water (for Construction and Testing): Furnish temporary water service.
1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection as per code. Water is available at no cost to the Contractor.
 2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR discretion) of use of water from Medical Center's system.
- G. Fuel: Natural and LP gas and burner fuel oil required for boiler cleaning, normal initial boiler-burner setup and adjusting, and for performing the specified boiler tests will be furnished by the Government. Fuel required for prolonged boiler-burner setup, adjustments, or modifications due to improper design or operation of boiler, burner, or control devices shall be furnished and paid by the Contractor at Contractor's expense.

1.18 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.
- B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center.
- C. Storage space for equipment will be provided by the Government and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Medical Center.
- D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.

- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.19 RELOCATED EQUIPMENT AND ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated or otherwise shown to be relocated by the Contractor.
- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, at the main whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- E. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

1.20 CONSTRUCTION SIGN

- A. Provide a Construction Sign where directed by the COR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the COR.
- D. Detail drawing of construction sign showing required legend and other characteristics of sign is to be determined and provided by the COR.

1.21 SAFETY SIGN

- A. Provide a Safety Sign where directed by COR. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.
- B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.

- C. Maintain sign and remove it when directed by COR.
- D. Standard Detail Drawing Number SD10000-02(Found on VA TIL) of safety sign showing required legend and other characteristics of sign is to be provided by the COR.
- E. Post the number of accident free days on a daily basis.

1.22 PHOTOGRAPHIC DOCUMENTATION

- A. Contractor to provide digital photographic exhibit of existing site and work performed. Digital color photos shall be taken from a digital camera with a minimum of 7.0 megapixels. Photos shall be transmitted to the COR by DVD in jpeg or tiff, and PDF formats. Each photo's electronic file size shall be a minimum of 300k with a maximum file size of 1.5meg.
- B. Photos shall document all phases of construction and shall be updated weekly until the project has been completed. Photos shall be submitted each month along with the project invoice for monthly payment.

1.23 HISTORIC PRESERVATION

- A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COR verbally, and then with a written follow up.

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**SECTION 01 32 16
PROJECT SCHEDULES**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The Contractor shall develop a Critical Path Method (CPM) plan and schedule demonstrating fulfillment of the contract requirements (Project Schedule), and shall keep the Project Schedule up-to-date in accordance with the requirements of this section and shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional Critical Path Method (CPM) technique shall be utilized to satisfy both time and cost applications.

1.02 CONTRACTOR'S REPRESENTATIVE

- A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting with and to the Contracting Officer's Representative (COR).
- B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this specification section.
- C. The Contractor's representative shall have the option of developing the project schedule within their organization or to engage the services of an outside consultant. If an outside scheduling consultant is utilized, Section 1.03 of this specification will apply.

1.03 CONTRACTOR'S CONSULTANT

- A. The Contractor shall submit a qualification proposal to the COR, within 10 days of bid acceptance. The qualification proposal shall include:
 - 1. The name and address of the proposed consultant.
 - 2. Information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.
 - 3. A representative sample of prior construction projects, which the proposed consultant has performed complete project scheduling services. These representative samples shall be of similar size and scope.
- B. The Contracting Officer has the right to approve or disapprove the proposed consultant, and will notify the Contractor of the VA decision within seven calendar days from receipt of the qualification proposal. In case of disapproval, the Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor shall have their scheduling consultant approved prior to submitting any schedule for approval.

1.04 COMPUTER PRODUCED SCHEDULES

- A. The contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly project updates. This monthly computer service will include: three copies of up to five different reports (inclusive of all pages) available within the user defined reports of the scheduling software approved by the Contracting Officer; a hard copy listing of all project schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the contractor's monthly payment request and the signed look

ahead report. The COR shall identify the five different report formats that the contractor shall provide.

- B. The contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also responsible for the accurate and timely submittal of the updated project schedule and all CPM data necessary to produce the computer reports and payment request that is specified.
- C. The VA will report errors in computer-produced reports to the Contractor's representative within ten calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports and associated diskette(s), when requested by the Contracting Officer's representative, to correct errors which affect the payment and schedule for the project.

1.05 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

- A. Within 10 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the Contracting Officer's review; three blue line copies of the interim schedule on sheets of paper 765 x 1070 mm (30 x 42 inches) and an electronic file in the previously approved CPM schedule program. The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints. Activity/event date constraints, not required by the contract, will not be accepted unless submitted to and approved by the Contracting Officer. The contractor shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the network diagram. The Contracting Officer's separate approval of the Project Schedule shall not excuse the contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete project. The final Project Schedule in its original form shall contain no contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire contract duration as defined in the bid documents. These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.
- B. Within 30 calendar days after receipt of the complete project interim Project Schedule and the complete final Project Schedule, the Contracting Officer or his representative, will do one or both of the following:
 - 1. Notify the Contractor concerning his actions, opinions, and objections.
 - 2. A meeting with the Contractor at or near the job site for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit three blue line copies of the revised Project Schedule, three copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

- C. The approved baseline schedule and the computer-produced schedule(s) generated there from shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this section.
- D. The Complete Project Schedule shall contain work activities / events to fully describe the construction phases and activities of the Contractor.

1.06 WORK ACTIVITY/EVENT COST DATA

- A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total contract price. Prorate overhead, profit and general conditions on all work activities/events for the entire project length. The contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.
- B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 – 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS).
- C. In accordance with FAR 52.236 – 1 (PERFORMANCE OF WORK BY THE CONTRACTOR) and VAAR 852.236 – 72 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.
- D. The Contractor shall cost load work activities/events for all BID ITEMS. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors' bid.

1.07 PROJECT SCHEDULE REQUIREMENTS

- A. Show on the project schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor Shall:
 - 1. Show activities/events as:
 - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 - b. Contracting Officer's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Facilities utilities, delivery of Government furnished equipment, and rough-in drawings, project phasing and any other specification requirements.
 - d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
 - e. VA inspection and acceptance activity/event with a minimum duration of five work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.

2. Show not only the activities/events for actual construction work for each trade category of the project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least five trades who are performing major work under this contract.
 3. Break up the work into activities/events of a duration no longer than 20 work days each or one reporting period, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the COR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will not be less than 20 work days.
 4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
 5. The schedule shall be generally numbered in such a way to reflect either discipline, phase or location of the work.
- B. The Contractor shall submit the following supporting data in addition to the project schedule:
1. The appropriate project calendar including working days and holidays.
 2. The planned number of shifts per day.
 3. The number of hours per shift.
- Failure of the Contractor to include this data shall delay the review of the submittal until the Contracting Officer is in receipt of the missing data.
- C. To the extent that the Project Schedule or any revised Project Schedule shows anything not jointly agreed upon, it shall not be deemed to have been approved by the COR. Failure to include any element of work required for the performance of this contract shall not excuse the Contractor from completing all work required within any applicable completion date of each phase regardless of the COR's approval of the Project Schedule.
- D. Compact Disk Requirements and CPM Activity/Event Record Specifications: Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete project schedule being submitted.

1.08 PAYMENT TO THE CONTRACTOR

- A. Monthly, the contractor shall submit the AIA application and certificate for payment documents G702 & G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 – 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 – 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated project schedule. Monthly payment requests shall include: a listing of all agreed upon project schedule changes and associated data; and an electronic file (s) of the resulting monthly updated schedule.
- B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the project schedule.

1.09 PAYMENT AND PROGRESS REPORTING

- A. Monthly schedule update meetings will be held on dates mutually agreed to by the COR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COR three work days in advance of the schedule update meeting. Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
 3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
 4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
 5. Completion percentage for all completed and partially completed activities/events.
 6. Logic and duration revisions required by this section of the specifications.
 7. Activity/event duration and percent complete shall be updated independently.
- B. After completion of the joint review, the contractor shall generate an updated computer-produced calendar-dated schedule and supply the Contracting Officer's representative with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.
- C. After completing the monthly schedule update, the contractor's representative or scheduling consultant shall rerun all current period contract change(s) against the prior approved monthly project schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the contractor and COR for the contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the resulting electronic project schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.04 and 1.07. This electronic submission is separate from the regular monthly project schedule update requirements and shall be submitted to the COR within fourteen (14) calendar days of completing the regular schedule update. Before inserting the contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.
- D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, COR, and all subcontractors needed, as determined by the SRE, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary actions required to maintain project schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain project schedule status during the reporting period. This schedule coordination meeting will occur after each monthly project schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the project schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION

- A. If it becomes apparent from the current revised monthly progress schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
 - 1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
 - 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
 - 3. Reschedule the work in conformance with the specification requirements.
- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the COR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE

- A. Within 30 calendar days after VA acceptance and approval of any updated project schedule, the Contractor shall submit a revised electronic file (s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
 - 1. Delay in completion of any activity/event or group of activities/events, which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the project beyond the acceptable limits.
 - 2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
 - 3. The schedule does not represent the actual prosecution and progress of the project.
 - 4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.
- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the Contracting Officer for approval.
- C. Contracting Officer's approval for the revised project schedule and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the VA representative.
- D. The cost of revisions to the project schedule resulting from contract changes will be included in the proposal for changes in work as specified in FAR 52.243 – 4 (Changes) and VAAR 852.236 – 88 (Changes – Supplemental), and will be based on the complexity of the revision or contract change, man hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

1.12 ADJUSTMENT OF CONTRACT COMPLETION

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information.
- B. Actual delays in activities/events which, according to the computer- produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Contracting Officer's decision.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under FAR 52.243 – 4 (Changes) and VAAR 852.236 – 88 (Changes – Supplemental). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in work days) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.
- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- 1.01 Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1.02 For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1.03 Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
 - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1.04 Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1.05 Prior to submission to Government for review, Contractor shall review and indicate Contractor's approval on submittals. Failure on the part of Contractor to indicate Contractor's approval on submittal prior to submission to University's Representative will result in the submittal being returned to Contractor without review.
- 1.06 Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Contracting Officer's Representative (COR) on behalf of the Contracting Officer.
- 1.07 Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1.08 The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1.09 Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and

Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.

- 1.10 Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
- A. Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
 - 1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
 - 2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
 - 3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
 - C. In addition to complying with the applicable requirements specified in preceding Article 1.09, samples which are required to have Laboratory Tests under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
 - 1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 - 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 - 3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
 - 4. Contractor shall send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 - 5. Laboratory test reports shall be sent directly to COR for appropriate action.
 - 6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 - 7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
 - D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted"

Sample" in addition to containing other previously specified information required on label and in transmittal letter.

- E. Approved samples will be kept on file by the COR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.
- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
 - 1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 - 2. Reproducible shall be full size.
 - 3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 - 4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 - 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 - 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 - 7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

1.11 Resubmittals:

- A. If a submittal is returned for correction by the Government, or is not satisfactory to the Government, resubmit the corrected material in the same quantity, including reproducibles, as specified for the original submittals.
- B. Make resubmittal within fourteen (14) calendar days after receipt by the Contractor of the returned material.
- C. If the same document is used for resubmittal, clear identify revised portions of the document by clouding.
- D. Keep each resubmittal intact and do not add new drawings, materials, or information outside the scope of the original submittal, except to answer comments. Partial resubmittals will not be accepted and will be returned without review.
- E. Contractor shall make a complete and acceptable submittal at least by second submission. The Government reserves the right to deduct monies from payments due to Contractor to cover additional costs of the Architect-Engineer's review beyond the second submission on any submittal.

- 1.12 If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- 1.13 Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

MEI Architects

(Architect-Engineer)

239 9th Street

(A/E P.O. Address)

San Francisco, California 94103

(City, State and Zip Code)

- 1.14 At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COR with "Material Approval Submittal (MAS)" sheet properly filled-up (see attached form). Each specification section submittal shall have a separate MAS. Comments on each submittal will be made on the MAS and will be returned by COR with or without the marked-up submittal depending on its complexity.

--- E N D ---

MATERIAL APPROVAL SUBMITTAL

Form Approved
OMB No 9000-0062
Expires Apr 30, 1993

(See Instructions on Reverse)

Public reporting burden for this collection of information is estimated to average 20 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project OMB No. 9000-0062, Washington, DC 20503. Please **DO NOT RETURN** your form to either of these addresses. Send your completed form to: SAF/AQCO, Pentagon, Washington, DC 20330-1000

TO: <i>(Contracting Officer)</i>	FROM: <i>(Contractor)</i>	DATE:
Department of Veterans Affairs		

CONTRACT NUMBER: VA261-C-00484	SUBMISSION NUMBER:	SUBMITTAL <input type="checkbox"/> NEW <input type="checkbox"/> RESUBMITTAL
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PREVIOUS SUBMISSION NUMBER:	PROJECT NUMBER
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TO BE COMPLETED BY CONTRACTOR			FOR GOVERNMENT USE ONLY			
ITEM NO.	SPECIFICATION SECTION/ PARA NO. /DRAWING NO.	DESCRIPTION OF MATERIAL <i>(Include Type, Model Number, Catalog No, Mfg., etc.)</i>	AP- PROVED	DISAP- PROVED	SEE REVERSE	INITIAL
01						
02						
03						
04						
05						
06						
07						
08						
09						

**BY COMPLETING THIS FORM, THE UNDERSIGNED CONTRACTOR CERTIFIES THAT
THE MATERIAL COMPLIES WITH ALL SPECIFICATIONS OF SUBJECT CONTRACT.**

DATE:	TYPE OR PRINT NAME AND TITLE	SIGNATURE
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FOR GOVERNMENT USE ONLY

Comments:

For Evaluation and Action

DATE:	TYPE OR PRINT NAME AND GRADE	SIGNATURE
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TO: *(AF Contracting Office)*

RECOMMEND	<input type="checkbox"/> APPROVAL	<input type="checkbox"/> DISAPPROVAL AS INDICATED ABOVE AND SUBJECT TO ANY APPLICABLE COMMENTS ON THE RESERVE
DATE:	TYPE OR PRINT NAME AND GRADE	SIGNATURE

TO: *(Contractor)*

APPROVED DISAPPROVED AS INDICATED ABOVE AND SUBJECT TO APPLICABLE COMMENTS ON RESERVE. REQUEST
RESUBMITTAL WITHIN _____ DAYS OF DATE SHOWN BELOW.

DATE:	TYPE OR PRINT NAME AND GRADE	SIGNATURE
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**SECTION 01 35 26
SAFETY REQUIREMENTS**

TABLE OF CONTENTS

1.01	APPLICABLE PUBLICATIONS.....	1
1.02	DEFINITIONS	1
1.03	REGULATORY REQUIREMENTS	2
1.04	ACCIDENT PREVENTION PLAN (APP)	2
1.05	ACTIVITY HAZARD ANALYSES (AHAs)	5
1.06	PRECONSTRUCTION CONFERENCE	6
1.07	“SITE SAFETY AND HEALTH OFFICER” (SSHO) and “COMPETENT PERSON” (CP)	6
1.08	TRAINING	7
1.09	INSPECTIONS.....	8
1.10	ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS	8
1.11	PERSONAL PROTECTIVE EQUIPMENT (PPE)	9
1.12	INFECTION CONTROL	9
1.13	FIRE SAFETY	13
1.14	ELECTRICAL	15
1.15	FALL PROTECTION	16
1.16	SCAFFOLDS AND OTHER WORK PLATFORMS	16
1.17	CRANES	17
1.18	CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT).....	17
1.19	WELDING AND CUTTING.....	17
1.20	LADDERS	18
1.21	FLOOR & WALL OPENINGS	18

SECTION 01 35 26
SAFETY REQUIREMENTS

1.01 APPLICABLE PUBLICATIONS

- A. Latest publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.
- B. American Society of Safety Engineers (ASSE):
 - A10.1-2011.....Pre-Project & Pre-Task Safety and Health Planning
 - A10.34-2012.....Protection of the Public on or Adjacent to Construction Sites
 - A10.38-2013.....Basic Elements of an Employer’s Program to Provide a Safe and Healthful Work Environment American National Standard Construction and Demolition Operations
- C. American Society for Testing and Materials (ASTM):
 - E84-2014.....Surface Burning Characteristics of Building Materials
- D. The Facilities Guidelines Institute (FGI):
 - FGI Guidelines-2010Guidelines for Design and Construction of Healthcare Facilities
- E. National Fire Protection Association (NFPA):
 - 10-2013.....Standard for Portable Fire Extinguishers
 - 30-2012.....Flammable and Combustible Liquids Code
 - 51B-2014.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work
 - 70-2014.....National Electrical Code
 - 70B-2013.....Recommended Practice for Electrical Equipment Maintenance
 - 70E-2012.....Standard for Electrical Safety in the Workplace
 - 99-2012.....Health Care Facilities Code
 - 241-2013.....Standard for Safeguarding Construction, Alteration, and Demolition Operations
- F. The Joint Commission (TJC)
 - TJC ManualComprehensive Accreditation and Certification Manual
- G. U.S. Nuclear Regulatory Commission
 - 10 CFR 20.....Standards for Protection Against Radiation
- H. U.S. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1904 ...Reporting and Recording Injuries & Illnesses
 - 29 CFR 1910 ...Safety and Health Regulations for General Industry
 - 29 CFR 1926 ...Safety and Health Regulations for Construction Industry
 - CPL 2-0.124.....Multi-Employer Citation Policy
- I. VHA Directive 2005-007

1.02 DEFINITIONS

- A. OSHA “Competent Person” (CP). One who is capable of identifying existing and predictable hazards in the surroundings and working conditions which are unsanitary, hazardous or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them (see 29 CFR 1926.32(f)).

- B. "Qualified Person" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.
- C. High Visibility Accident. Any mishap which may generate publicity or high visibility.
- D. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.
- E. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:
 - 1. Death, regardless of the time between the injury and death, or the length of the illness;
 - 2. Days away from work (any time lost after day of injury/illness onset);
 - 3. Restricted work;
 - 4. Transfer to another job;
 - 5. Medical treatment beyond first aid;
 - 6. Loss of consciousness; or
 - 7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

1.03 REGULATORY REQUIREMENTS

- A. In addition to the detailed requirements included in the provisions of this contract, comply with 29 CFR 1926, comply with 29 CFR 1910 as incorporated by reference within 29 CFR 1926, comply with ASSE A10.34, and all applicable [federal, state, and local] laws, ordinances, criteria, rules and regulations [_____]. Submit matters of interpretation of standards for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern except with specific approval and acceptance by the Contracting Officer.

1.04 ACCIDENT PREVENTION PLAN (APP)

- A. The APP (aka Construction Safety & Health Plan) shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and ensure it is site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all worksite safety and health of each subcontractor(s). Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.
- B. The APP shall be prepared as follows:
 - 1. Written in English by a qualified person who is employed by the Prime Contractor articulating the specific work and hazards pertaining to the contract (model language can be found in ASSE A10.33). Specifically articulating the safety requirements found within these VA contract safety specifications.
 - 2. Address both the Prime Contractors and the subcontractors work operations.
 - 3. State measures to be taken to control hazards associated with materials, services, or equipment provided by suppliers.
 - 4. Address all the elements/sub-elements and in order as follows:

- a. **SIGNATURE SHEET.** Title, signature, and phone number of the following:
 - i. Plan preparer (Qualified Person such as corporate safety staff person or contracted Certified Safety Professional with construction safety experience);
 - ii. Plan approver (company/corporate officers authorized to obligate the company);
 - iii. Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional). Provide concurrence of other applicable corporate and project personnel (Contractor).
- b. **BACKGROUND INFORMATION.** List the following:
 - i. Contractor;
 - ii. Contract number;
 - iii. Project name;
 - iv. Brief project description, description of work to be performed, and location; phases of work anticipated (these will require an AHA).
- c. **STATEMENT OF SAFETY AND HEALTH POLICY.** Provide a copy of current corporate/company Safety and Health Policy Statement, detailing commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract should be provided.
- d. **RESPONSIBILITIES AND LINES OF AUTHORITIES.** Provide the following:
 - i. A statement of the employer's ultimate responsibility for the implementation of his SOH program;
 - ii. Identification and accountability of personnel responsible for safety at both corporate and project level. Contracts specifically requiring safety or industrial hygiene personnel shall include a copy of their resumes.
 - iii. The names of Competent and/or Qualified Person(s) and proof of competency/qualification to meet specific OSHA Competent/Qualified Person(s) requirements must be attached;
 - iv. Requirements that no work shall be performed unless a designated competent person is present on the job site;
 - v. Requirements for pre-task Activity Hazard Analysis (AHAs);
 - vi. Lines of authority;
 - vii. Policies and procedures regarding noncompliance with safety requirements (to include disciplinary actions for violation of safety requirements) should be identified;
- e. **SUBCONTRACTORS AND SUPPLIERS.** If applicable, provide procedures for coordinating SOH activities with other employers on the job site:
 - i. Identification of subcontractors and suppliers (if known);
 - ii. Safety responsibilities of subcontractors and suppliers.
- f. **TRAINING.**
 - i. Site-specific SOH orientation training at the time of initial hire or assignment to the project for every employee before working on the project site is required.
 - ii. Mandatory training and certifications that are applicable to this project (e.g., explosive actuated tools, crane operator, rigger, crane signal person, fall protection, electrical lockout/NFPA 70E,

- iii. machine/equipment lockout, confined space, etc...) and any requirements for periodic retraining/recertification are required.
- iii. Procedures for ongoing safety and health training for supervisors and employees shall be established to address changes in site hazards/conditions.
- iv. OSHA 10-hour training is required for all workers on site and the OSHA 30-hour training is required for Trade Competent Persons (CPs)
- g. SAFETY AND HEALTH INSPECTIONS.**
 - i. Specific assignment of responsibilities for a minimum daily job site safety and health inspection during periods of work activity: Who will conduct (e.g., "Site Safety and Health CP"), proof of inspector's training/qualifications, when inspections will be conducted, procedures for documentation, deficiency tracking system, and follow-up procedures.
 - ii. Any external inspections/certifications that may be required (e.g., contracted CSP or CSHT)
- h. ACCIDENT INVESTIGATION & REPORTING.** The Contractor shall conduct mishap investigations of all OSHA Recordable Incidents. The APP shall include accident/incident investigation procedure & identify person(s) responsible to provide the following to the Contracting Officer Representative:
 - i. Exposure data (man-hours worked);
 - ii. Accident investigations, reports, and logs.
- i. PLANS (PROGRAMS, PROCEDURES) REQUIRED.** Based on a risk assessment of contracted activities and on mandatory OSHA compliance programs, the Contractor shall address all applicable occupational risks in site-specific compliance and accident prevention plans. These Plans shall include but are not be limited to procedures for addressing the risks associates with the following:
 - i. Emergency response ;
 - ii. Contingency for severe weather;
 - iii. Fire Prevention ;
 - iv. Medical Support;
 - v. Posting of emergency telephone numbers;
 - vi. Prevention of alcohol and drug abuse;
 - vii. Site sanitation (housekeeping, drinking water, toilets);
 - viii. Night operations and lighting ;
 - ix. Hazard communication program;
 - x. Welding/Cutting "Hot" work ;
 - xi. Electrical Safe Work Practices (Electrical LOTO/NFPA 70E);
 - xii. General Electrical Safety
 - xiii. Hazardous energy control (Machine LOTO);
 - xiv. Site-Specific Fall Protection & Prevention;
 - xv. Excavation/trenching;
 - xvi. Asbestos abatement;
 - xvii. Lead abatement;
 - xviii. Crane Critical lift;
 - xix. Respiratory protection;
 - xx. Health hazard control program;
 - xxi. Radiation Safety Program;
 - xxii. Abrasive blasting;
 - xxiii. Heat/Cold Stress Monitoring;
 - xxiv. Crystalline Silica Monitoring (Assessment);

- xxv. Demolition plan (to include engineering survey);
 - xxvi. Formwork and shoring erection and removal;
 - xxvii. PreCast Concrete.
- C. Submit the APP to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.
- D. Once accepted by the Contracting Officer Representative, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.
- E. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Project Manager, project overall designated OSHA Competent Person, and Contracting Officer Representative. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34) and the environment.

1.05 ACTIVITY HAZARD ANALYSES (AHAS)

- A. AHAs are also known as Job Hazard Analyses, Job Safety Analyses, and Activity Safety Analyses. Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or sub-contractor is to perform the work, the Contractor(s) performing that work activity shall prepare an AHA (Example electronic AHA forms can be found on the US Army Corps of Engineers web site)
- B. AHAs shall define the activities being performed and identify the work sequences, the specific anticipated hazards, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk.
- C. Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
1. The names of the Competent/Qualified Person(s) required for a particular activity (for example, excavations, scaffolding, fall protection, other activities as specified by OSHA and/or other State and Local agencies) shall be identified and included in the AHA. Certification of their competency/qualification shall be submitted to the Government Designated Authority (GDA) for acceptance prior to the start of that work activity.
 2. The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).
 - a. If more than one Competent/Qualified Person is used on the AHA activity, a list of names shall be submitted as an attachment to the AHA. Those listed must be Competent/Qualified for the type of work involved in the AHA and familiar with current site safety issues.
 - b. If a new Competent/Qualified Person (not on the original list) is added, the list shall be updated (an administrative action not requiring an

- updated AHA). The new person shall acknowledge in writing that he or she has reviewed the AHA and is familiar with current site safety issues.
3. Submit AHAs to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES for review at least 15 [] calendar days prior to the start of each phase. Subsequent AHAs as shall be formatted as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.
 4. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
 5. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. All activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier, or subcontractor and provided to the prime contractor for review and approval and then submitted to Contracting Officer Representative.

1.06 PRECONSTRUCTION CONFERENCE

- A. Contractor representatives who have a responsibility or significant role in implementation of the accident prevention program, as required by 29 CFR 1926.20(b)(1), on the project shall attend the preconstruction conference to gain a mutual understanding of its implementation. This includes the project superintendent, subcontractor superintendents, and any other assigned safety and health professionals.
- B. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
- C. Deficiencies in the submitted APP will be brought to the attention of the Contractor within 14 days of submittal, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.07 "SITE SAFETY AND HEALTH OFFICER" (SSHO) AND "COMPETENT PERSON" (CP)

- A. The Prime Contractor shall designate a minimum of one SSHO at each project site that will be identified as the SSHO to administer the Contractor's safety program and government-accepted Accident Prevention Plan. Each subcontractor shall designate a minimum of one CP in compliance with 29 CFR 1926.20 (b)(2) that will be identified as a CP to administer their individual safety programs.
- B. Further, all specialized Competent Persons for the work crews will be supplied by the respective contractor as required by 29 CFR 1926 (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).
- C. These Competent Persons can have collateral duties as the subcontractor's superintendent and/or work crew lead persons as well as fill more than one specialized CP role (i.e. Asbestos, Electrical, Cranes, & Derricks, Demolition, Fall Protection, Fire Safety/Life Safety, Ladder, Rigging, Scaffolds, and Trenches/Excavations).

- D. The SSHO or an equally-qualified Designated Representative/alternate will maintain a presence on the site during construction operations in accordance with FAR Clause 52.236-6: *Superintendence by the Contractor*. CPs will maintain presence during their construction activities in accordance with above mentioned clause. A listing of the designated SSHO and all known CPs shall be submitted prior to the start of work as part of the APP with the training documentation and/or AHA as listed in Section 1.8 below.
- E. The repeated presence of uncontrolled hazards during a contractor's work operations will result in the designated CP as being deemed incompetent and result in the required removal of the employee in accordance with FAR Clause 52.236-5: Material and Workmanship, Paragraph (c).

1.08 TRAINING

- A. The designated Prime Contractor SSHO must meet the requirements of all applicable OSHA standards and be capable (through training, experience, and qualifications) of ensuring that the requirements of 29 CFR 1926.16 and other appropriate Federal, State and local requirements are met for the project. As a minimum the SSHO must have completed the OSHA 30-hour Construction Safety class and have five (5) years of construction industry safety experience or three (3) years if he/she possesses a Certified Safety Professional (CSP) or certified Construction Safety and Health Technician (CSHT) certification or have a safety and health degree from an accredited university or college.
- B. All designated CPs shall have completed the OSHA 30-hour Construction Safety course within the past 5 years.
- C. In addition to the OSHA 30 Hour Construction Safety Course, all CPs with high hazard work operations such as operations involving asbestos, electrical, cranes, demolition, work at heights/fall protection, fire safety/life safety, ladder, rigging, scaffolds, and trenches/excavations shall have a specialized formal course in the hazard recognition & control associated with those high hazard work operations. Documented "repeat" deficiencies in the execution of safety requirements will require retaking the requisite formal course.
- D. All other construction workers shall have the OSHA 10-hour Construction Safety Outreach course and any necessary safety training to be able to identify hazards within their work environment.
- E. Submit training records associated with the above training requirements to the Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES 15 [] calendar days prior to the date of the preconstruction conference for acceptance.
- F. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the SSHO or his/her designated representative. As a minimum, this briefing shall include information on the site-specific hazards, construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, emergency procedures, accident reporting etc... Documentation shall be provided to the Contracting Officer's Representative that individuals have undergone contractor's safety briefing.
- G. Ongoing safety training will be accomplished in the form of weekly documented safety meeting.

1.09 INSPECTIONS

- A. The SSHO shall conduct frequent and regular safety inspections (daily) of the site and each of the subcontractors CPs shall conduct frequent and regular safety inspections (daily) of their work operations as required by 29 CFR 1926.20(b)(2). Each week, the SSHO shall conduct a formal documented inspection of the entire construction areas with the subcontractors' "Trade Safety and Health CPs" present in their work areas. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative.
- B. A Certified Safety Professional (CSP) with specialized knowledge in construction safety or a certified Construction Safety and Health Technician (CSHT) shall randomly conduct a monthly site safety inspection. The CSP or CSHT can be a corporate safety professional or independently contracted. The CSP or CSHT will provide their certificate number on the required report for verification as necessary.
 - 1. Results of the inspection will be documented with tracking of the identified hazards to abatement.
 - 2. The Contracting Officer Representative will be notified immediately prior to start of the inspection and invited to accompany the inspection.
 - 3. Identified hazard and controls will be discussed to come to a mutual understanding to ensure abatement and prevent future reoccurrence.
 - 4. A report of the inspection findings with status of abatement will be provided to the Contracting Officer Representative within one week of the onsite inspection.

1.10 ACCIDENTS, OSHA 300 LOGS, AND MAN-HOURS

- A. Notify the Contracting Officer Representative as soon as practical, but no more than four hours after any accident meeting the definition of OSHA Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$5,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Contracting Officer Representative determine whether a government investigation will be conducted.
- B. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, and property damage accidents resulting in at least \$20,000 in damages, to establish the root cause(s) of the accident. Complete the VA Form 2162, and provide the report to the Contracting Officer Representative within 5 calendar days of the accident. The Contracting Officer Representative will provide copies of any required or special forms.
- C. A summation of all man-hours worked by the contractor and associated sub-contractors for each month will be reported to the Contracting Officer Representative monthly.
- D. A summation of all OSHA recordable accidents experienced on site by the contractor and associated sub-contractors for each month will be provided to the Contracting Officer Representative monthly. The contractor and associated sub-contractors' OSHA 300 logs will be made available to the Contracting Officer Representative as requested.

1.11 PERSONAL PROTECTIVE EQUIPMENT (PPE)

- A. PPE is governed in all areas by the nature of the work the employee is performing. For example, specific PPE required for performing work on electrical equipment is identified in NFPA 70E, Standard for Electrical Safety in the Workplace.
- B. Mandatory PPE includes:
 - 1. Hard Hats – unless written authorization is given by the Contracting Officer Representative in circumstances of work operations that have limited potential for falling object hazards such as during finishing work or minor remodeling. With authorization to relax the requirement of hard hats, if a worker becomes exposed to an overhead falling object hazard, then hard hats would be required in accordance with the OSHA regulations.
 - 2. Safety glasses - unless written authorization is given by the Contracting Officer Representative appropriate safety glasses meeting the ANSI Z.87.1 standard must be worn by each person on site.
 - 3. Appropriate Safety Shoes – based on the hazards present, safety shoes meeting the requirements of ASTM F2413-11 shall be worn by each person on site unless written authorization is given by the Contracting Officer Representative.
 - 4. Hearing protection - Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks.

1.12 INFECTION CONTROL

- A. Infection Control is critical in all medical center facilities. Interior construction activities causing disturbance of existing dust, or creating new dust, must be conducted within ventilation-controlled areas that minimize the flow of airborne particles into patient areas.
- B. An AHA associated with infection control will be performed by VA personnel in accordance with FGI Guidelines (i.e. Infection Control Risk Assessment (ICRA)). The ICRA procedure found on the American Society for Healthcare Engineering (ASHE) website will be utilized. Risk classifications of Class II or lower will require approval by the Contracting Officer Representative before beginning any construction work. Risk classifications of Class III or higher will require a permit before beginning any construction work. Infection Control permits will be issued by the Contracting Officer's Representative. The Infection Control Permits will be posted outside the appropriate construction area. More than one permit may be issued for a construction project if the work is located in separate areas requiring separate classes. The primary project scope area for this project is: **Class II**, however, work outside the primary project scope area may vary. The required infection control precautions with each class are as follows:
 - 1. Class I requirements:
 - a. During Construction Work:
 - i. Notify the Contracting Officer Representative.
 - ii. Execute work by methods to minimize raising dust from construction operations.
 - iii. Ceiling tiles: Immediately replace a ceiling tiles displaced for visual inspection.
 - b. Upon Completion:
 - i. Clean work area upon completion of task
 - ii. Notify the Contracting Officer Representative.
 - 2. Class II requirements:
 - a. During Construction Work:
 - i. Notify the Contracting Officer Representative.

- ii. Provide active means to prevent airborne dust from dispersing into atmosphere such as wet methods or tool mounted dust collectors where possible.
 - iii. Water mist work surfaces to control dust while cutting.
 - iv. Seal unused doors with duct tape.
 - v. Block off and seal air vents.
 - vi. Remove or isolate HVAC system in areas where work is being performed.
 - b. Upon Completion:
 - i. Wipe work surfaces with cleaner/disinfectant.
 - ii. Contain construction waste before transport in tightly covered containers.
 - iii. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
 - iv. Upon completion, restore HVAC system where work was performed
 - v. Notify the Contracting Officer Representative.
- 3. Class III requirements:
 - a. During Construction Work:
 - i. Obtain permit from the Contracting Officer Representative.
 - ii. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
 - iii. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
 - iv. Maintain negative air pressure, 0.01 inches of water gauge, within work site utilizing HEPA equipped air filtration units and continuously monitored with a digital display, recording and alarm instrument, which must be calibrated on installation, maintained with periodic calibration and monitored by the contractor.
 - v. Contain construction waste before transport in tightly covered containers.
 - vi. Cover transport receptacles or carts. Tape covering unless solid lid.
 - b. Upon Completion:
 - i. Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative and thoroughly cleaned by the VA Environmental Services Department.
 - ii. Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
 - iii. Vacuum work area with HEPA filtered vacuums.
 - iv. Wet mop area with cleaner/disinfectant.
 - v. Upon completion, restore HVAC system where work was performed.
 - vi. Return permit to the Contracting Officer Representative.
- 4. Class IV requirements:
 - a. During Construction Work:

- i. Obtain permit from Contracting Officer Representative // or Government Designated Authority.
 - ii. Isolate HVAC system in area where work is being done to prevent contamination of duct system.
 - iii. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non-work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Install construction barriers and ceiling protection carefully, outside of normal work hours.
 - iv. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
 - v. Seal holes, pipes, conduits, and punctures.
 - vi. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.
 - vii. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.
 - b. Upon Completion:
 - i. Do not remove barriers from work area until completed project is inspected by the Contracting Officer Representative with thorough cleaning by the VA Environmental Services Dept.
 - ii. Remove construction barriers and ceiling protection carefully to minimize spreading of dirt and debris associated with construction, outside of normal work hours.
 - iii. Contain construction waste before transport in tightly covered containers.
 - iv. Cover transport receptacles or carts. Tape covering unless solid lid.
 - v. Vacuum work area with HEPA filtered vacuums.
 - vi. Wet mop area with cleaner/disinfectant.
 - vii. Upon completion, restore HVAC system where work was performed.
 - viii. Return permit to the Contracting Officer Representative.
- C. Barriers shall be erected as required based upon classification (Class III & IV requires barriers) and shall be constructed as follows:
 - 1. Class III and IV - closed door with masking tape applied over the frame and door is acceptable for projects that can be contained in a single room.
 - 2. Construction, demolition or reconstruction not capable of containment within a single room must have the following barriers erected and made presentable on hospital occupied side:
 - a. Class III & IV (where dust control is the only hazard, and an agreement is reached with Contracting Officer Representative and Medical Center) - Airtight plastic barrier that extends from the floor to ceiling. Seams must be sealed with duct tape to prevent dust and debris from escaping
 - b. Class III & IV - Drywall barrier erected with joints covered or sealed to prevent dust and debris from escaping.
 - c. Class III & IV - Seal all penetrations in existing barrier airtight
 - d. Class III & IV - Barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement air and debris

- e. Class IV only - Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing
 - f. Class III & IV - At elevators shafts or stairways within the field of construction, overlapping flap minimum of two feet wide of polyethylene enclosures for personnel access.
- D. Products and Materials:
- 1. Sheet Plastic: Fire retardant polystyrene, 6-mil thickness meeting local fire codes
 - 2. Barrier Doors: Self Closing One-hour fire-rated solid core wood in steel frame, painted
 - 3. Dust proof one-hour fire-rated.
 - 4. High Efficiency Particulate Air-Equipped filtration machine rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Maintenance of equipment and replacement of the HEPA filters and other filters will be in accordance with manufacturer's instructions.
 - 5. Exhaust Hoses: Heavy duty, flexible steel reinforced; Ventilation Blower Hose
 - 6. Adhesive Walk-off Mats: Provide minimum size mats of 24 inches x 36 inches
 - 7. Disinfectant: Hospital-approved disinfectant or equivalent product
 - 8. Portable Ceiling Access Module
- E. Before any construction on site begins, all contractor personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- F. A dust control program will be establish and maintained as part of the contractor's infection preventive measures in accordance with the FGI Guidelines for Design and Construction of Healthcare Facilities. Prior to start of work, prepare a plan detailing project-specific dust protection measures with associated product data, including periodic status reports, and submit to Project Engineer and Facility CSC for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- G. Medical center Infection Control personnel will monitor for airborne disease (e.g. aspergillosis) during construction. A baseline of conditions will be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality with safe thresholds established.
- H. In general, the following preventive measures shall be adopted during construction to keep down dust and prevent mold.
- 1. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. HEPA filtration is required where the exhaust dust may reenter the medical center.
 - 2. Exhaust hoses shall be exhausted so that dust is not reintroduced to the medical center.
 - 3. Adhesive Walk-off/Carpet Walk-off Mats shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.
 - 4. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration.

- Maintain surrounding area frequently. Remove debris as it is created. Transport these outside the construction area in containers with tightly fitting lids.
5. The contractor shall not haul debris through patient-care areas without prior approval of the Contracting Officer Representative and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
 6. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.
 7. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.
- I. Final Cleanup:
1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
 2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
 3. All new air ducts shall be cleaned prior to final inspection.
- J. Exterior Construction:
1. Contractor shall verify that dust will not be introduced into the medical center through intake vents, or building openings. HEPA filtration on intake vents is required where dust may be introduced.
 2. Dust created from disturbance of soil such as from vehicle movement will be wetted with use of a water truck as necessary.
 3. All cutting, drilling, grinding, sanding or disturbance of materials shall be accomplished with tools equipped with either local exhaust ventilation (i.e. vacuum systems) or wet suppression controls.

1.13 FIRE SAFETY

- A. Fire Safety Plan: Establish and maintain a site-specific fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Contracting Officer Representative for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. This plan may be an element of the Accident Prevention Plan.
- B. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.
- C. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).

- D. Temporary Construction Partitions:
 - 1. Install and maintain temporary construction partitions to provide smoke-tight separations between construction areas and adjoining areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire retardant treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾ hour fire/smoke rated doors with self-closing devices.
 - 2. Install one-hour fire-rated temporary construction partitions as shown on drawings to maintain integrity of existing exit stair enclosures, exit passageways, fire-rated enclosures of hazardous areas, horizontal exits, smoke barriers, vertical shafts and openings enclosures.
 - 3. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.
- E. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- F. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Contracting Officer Representative.
- G. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Contracting Officer Representative.
- H. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- I. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- J. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.
- K. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Contracting Officer Representative. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Resident Engineer.
- L. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Contracting Officer Representative.
- M. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative to obtain permits from Facility Safety Officer at least twenty four (24) hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
- N. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Contracting Officer Representative.

- O. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- P. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.

1.14 ELECTRICAL

- A. All electrical work shall comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, 29 CFR Part 1910 Subpart J – General Environmental Controls, 29 CFR Part 1910 Subpart S – Electrical, and 29 CFR 1926 Subpart K in addition to other references required by contract.
- B. All qualified persons performing electrical work under this contract shall be licensed journeyman or master electricians. All apprentice electricians performing under this contract shall be deemed unqualified persons unless they are working under the immediate supervision of a licensed electrician or master electrician.
- C. All electrical work will be accomplished de-energized and in the Electrically Safe Work Condition (refer to NFPA 70E for Work Involving Electrical Hazards, including Exemptions to Work Permit). Any Contractor, subcontractor or temporary worker who fails to fully comply with this requirement is subject to immediate termination in accordance with FAR clause 52.236-5(c). Only in rare circumstance where achieving an electrically safe work condition prior to beginning work would increase or cause additional hazards, or is infeasible due to equipment design or operational limitations is energized work permitted. The Contracting Officer Representative with approval of the Medical Center Director will make the determination if the circumstances would meet the exception outlined above. An AHA specific to energized work activities will be developed, reviewed, and accepted prior to the start of that work.
 - 1. Development of a Hazardous Electrical Energy Control Procedure is required prior to de-energization. A single Simple Lockout/Tagout Procedure for multiple work operations can only be used for work involving qualified person(s) de-energizing one set of conductors or circuit part source. Task specific Complex Lockout/Tagout Procedures are required at all other times.
 - 2. Verification of the absence of voltage after de-energization and lockout/tagout is considered “energized electrical work” (live work) under NFPA 70E, and shall only be performed by qualified persons wearing appropriate shock protective (voltage rated) gloves and arc rate personal protective clothing and equipment, using Underwriters Laboratories (UL) tested and appropriately rated contact electrical testing instruments or equipment appropriate for the environment in which they will be used.
 - 3. Personal Protective Equipment (PPE) and electrical testing instruments will be readily available for inspection by the Contracting Officer Representative.
- D. Before beginning any electrical work, an Activity Hazard Analysis (AHA) will be conducted to include Shock Hazard and Arc Flash Hazard analyses (NFPA Tables can be used only as a last alternative and it is strongly suggested a full Arc Flash Hazard Analyses be conducted). Work shall not begin until the AHA for the work activity has been accepted by the Contracting Officer Representative and discussed with all engaged in the activity, including the Contractor, subcontractor(s), and Government on-site representatives at preparatory and initial control phase meetings.
- E. Ground-fault circuit interrupters. All 120-volt, single-phase 15- and 20-ampere receptacle outlets on construction sites shall have approved ground-fault circuit interrupters for personnel protection. “Assured Equipment Grounding Conductor Program” only is not allowed.

1.15 FALL PROTECTION

- A. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) for ALL WORK, unless specified differently or the OSHA 29 CFR 1926 requirements are more stringent, to include steel erection activities, systems-engineered activities (prefabricated) metal buildings, residential (wood) construction and scaffolding work.
 - 1. The use of a Safety Monitoring System (SMS) as a fall protection method is prohibited.
 - 2. The use of Controlled Access Zone (CAZ) as a fall protection method is prohibited.
 - 3. Fall protection while using a ladder will be governed by the OSHA requirements.

1.16 SCAFFOLDS AND OTHER WORK PLATFORMS

- A. All scaffolds and other work platforms construction activities shall comply with 29 CFR 1926 Subpart L.
- B. The fall protection (FP) threshold height requirement is 6 ft (1.8 m) as stated in Section 1.16.
- C. The following hierarchy and prohibitions shall be followed in selecting appropriate work platforms.
 - 1. Scaffolds, platforms, or temporary floors shall be provided for all work except that can be performed safely from the ground or similar footing.
 - 2. Ladders less than 20 feet may be used as work platforms only when use of small hand tools or handling of light material is involved.
 - 3. Ladder jacks, lean-to, and prop-scaffolds are prohibited.
 - 4. Emergency descent devices shall not be used as working platforms.
- D. Contractors shall use a scaffold tagging system in which all scaffolds are tagged by the Competent Person. Tags shall be color-coded: green indicates the scaffold has been inspected and is safe to use; red indicates the scaffold is unsafe to use. Tags shall be readily visible, made of materials that will withstand the environment in which they are used, be legible and shall include:
 - 1. The Competent Person's name and signature;
 - 2. Dates of initial and last inspections.
- E. Mast Climbing work platforms: When access ladders, including masts designed as ladders, exceed 20 ft (6m) in height, positive fall protection shall be used.

1.17 EXCAVATION AND TRENCHES

- A. All excavation and trenching work shall comply with 29 CFR 1926 Subpart P.
- B. All excavations and trenches 5 feet in depth or greater shall require a written trenching and excavation permit (NOTE – some States and other local jurisdictions require separate state/jurisdiction-issued excavation permits). The permit shall be completed and provided to the COR and other Government Designated Authority prior to commencing work for the day. At the end of the day, the permit shall be closed out and provided to the COR and other Government Designated Authority. The permit shall be maintained onsite and include the following:
 - 1. Determination of soil classification.
 - 2. Indication that utilities have been located and identified. If utilities could not be located after all reasonable attempt, then excavating operations will proceed cautiously.
 - 3. Indication of selected excavation protective system.

4. Indication that the spoil pile will be stored at least 2 feet from the edge of the excavation and safe access provided within 25 feet of the workers.
 5. Indication of assessment for a potential toxic, explosive, or oxygen deficient atmosphere.
- C. If not using an engineered protective system such as a trench box, shielding, shoring, or other Professional Engineer designed system and using a sloping or benching system, soil classification cannot be Solid Rock or Type A. All soil will be classified as Type B or Type C and sloped or benched in accordance with Appendix B of 29 CFR 1926.

1.17 CRANES

- A. All crane work shall comply with 29 CFR 1926 Subpart CC.
- B. Prior to operating a crane, the operator must be licensed, qualified or certified to operate the crane. Thus, all the provisions contained with Subpart CC are effective and there is no "Phase In" date of November 10, 2014.
- C. A detailed lift permit shall be submitted 14 days prior to the scheduled lift complete with route for truck carrying load, crane load analysis, siting of crane and path of swing. The lift will not be allowed without approval of this document.
- D. Crane operators shall not carry loads
 1. over the general public or VAMC personnel
 2. over any occupied building unless
 - a. the top two floors are vacated
 - b. or overhead protection with a design live load of 300 psf is provided

1.18 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

- A. All installation, maintenance, and servicing of equipment or machinery shall comply with 29 CFR 1910.147 except for specifically referenced operations in 29 CFR 1926 such as concrete & masonry equipment [1926.702(j)], heavy machinery & equipment [1926.600(a)(3)(i)], and process safety management of highly hazardous chemicals (1926.64). Control of hazardous electrical energy during the installation, maintenance, or servicing of electrical equipment shall comply with Section 1.15 to include NFPA 70E and other VA specific requirements discussed in the section.

1.19 CONFINED SPACE ENTRY

- A. All confined space entry shall comply with 29 CFR 1910.146 except for specifically referenced operations in 29 CFR 1926 such as excavations/trenches [1926.651(g)].
- B. A site-specific Confined Space Entry Plan (including permitting process) shall be developed and submitted to the Contracting Officer's Representative.

1.19 WELDING AND CUTTING

As specified in section 1.14, Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Contracting Officer Representative and Facility Safety Manager. Obtain permits from Contracting Officer Representative and Facility Safety Manager at least twenty four (24) hours in advance. Designate contractor's responsible project-site fire prevention program manager to permit hot work.

1.20 LADDERS

- A. All Ladder use shall comply with 29 CFR 1926 Subpart X.
- B. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.
- C. Manufacturer safety labels shall be in place on ladders
- D. Step Ladders shall not be used in the closed position
- E. Top steps or cap of step ladders shall not be used as a step
- F. Portable ladders, used as temporary access, shall extend at least 3 ft (0.9 m) above the upper landing surface.
 - 1. When a 3 ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist workers in mounting and dismounting the ladder.
 - 2. In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.
- G. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use. Broken or damaged ladders shall be immediately tagged "DO NOT USE," or with similar wording, and withdrawn from service until restored to a condition meeting their original design.

1.21 FLOOR & WALL OPENINGS

- A. All floor and wall openings shall comply with 29 CFR 1926 Subpart M.
- B. Floor holes/openings are any that measure over 2 in (51 mm) in any direction of a walking/working surface which persons may trip or fall into or where objects may fall to the level below. See 21.F for covering and labeling requirements.
- C. All floor openings or hole into which a person can accidentally walk or fall through shall be guarded either by a railing system with toeboards along all exposed sides or a load-bearing cover. When the cover is not in place, the opening or hole shall be protected by a removable guardrail system or shall be attended when the guarding system has been removed, or other fall protection system.
 - 1. Covers shall be capable of supporting, without failure, at least twice the weight of the worker, equipment and material combined.
 - 2. Covers shall be secured when installed, clearly marked with the word "HOLE", "COVER" or "Danger, Roof Opening-Do Not Remove" or color-coded or equivalent methods (e.g., red or orange "X"). Workers must be made aware of the meaning for color coding and equivalent methods.
 - 3. Roofing material, such as roofing membrane, insulation or felts, covering or partly covering openings or holes, shall be immediately cut out. No hole or opening shall be left unattended unless covered.
 - 4. Non-load-bearing skylights shall be guarded by a load-bearing skylight screen cover, or railing system along all exposed sides.
 - 5. Workers are prohibited from standing/walking on skylights.

--- E N D ---

**SECTION 01 42 19
REFERENCE STANDARDS**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.02 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

- A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to – GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L’Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.
- B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.03 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)

- A. The specifications and standards cited in this solicitation can be examined at the following location:

DEPARTMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
425 Eye Street N.W, (sixth floor)
Washington, DC 20001
Telephone Numbers: (202) 632-5249 or (202) 632-5178
Between 9:00 AM - 3:00 PM

1.04 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

- A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below:

AA Aluminum Association Inc.
<http://www.aluminum.org>

AABC	Associated Air Balance Council http://www.aabchq.com
AAMA	American Architectural Manufacturer's Association http://www.aamanet.org
AAN	American Nursery and Landscape Association http://www.anla.org
AASHTO	American Association of State Highway and Transportation Officials http://www.aashto.org
AATCC	American Association of Textile Chemists and Colorists http://www.aatcc.org
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgih.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
ADC	Air Diffusion Council http://flexibleduct.org
AGA	American Gas Association http://www.aga.org
AGC	Associated General Contractors of America http://www.agc.org
AGMA	American Gear Manufacturers Association, Inc. http://www.agma.org
AHAM	Association of Home Appliance Manufacturers http://www.aham.org
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org
AITC	American Institute of Timber Construction http://www.aitc-glulam.org
AMCA	Air Movement and Control Association, Inc. http://www.amca.org

ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	The Engineered Wood Association http://www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute http://www.ari.org
ASAE	American Society of Agricultural Engineers http://www.asae.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers http://www.ashrae.org
ASME	American Society of Mechanical Engineers http://www.asme.org
ASSE	American Society of Sanitary Engineering http://www.asse-plumbing.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	Brick Institute of America http://www.bia.org
CAGI	Compressed Air and Gas Institute http://www.cagi.org
CGA	Compressed Gas Association, Inc. http://www.cganet.com
CI	The Chlorine Institute, Inc. http://www.chlorineinstitute.org

CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute http://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CPMB	Concrete Plant Manufacturers Bureau http://www.cpmc.org
CRA	California Redwood Association http://www.calredwood.org
CRSI	Concrete Reinforcing Steel Institute http://www.crsi.org
CTI	Cooling Technology Institute http://www.cti.org
DHI	Door and Hardware Institute http://www.dhi.org
EGSA	Electrical Generating Systems Association http://www.egsa.org
EEI	Edison Electric Institute http://www.eei.org
EPA	Environmental Protection Agency http://www.epa.gov
ETL	ETL Testing Laboratories, Inc. http://www.et1.com
FAA	Federal Aviation Administration http://www.faa.gov
FCC	Federal Communications Commission http://www.fcc.gov
FPS	The Forest Products Society http://www.forestprod.org
GANA	Glass Association of North America http://www.cssinfo.com/info/gana.html/
FM	Factory Mutual Insurance http://www.fmglobal.com
GA	Gypsum Association http://www.gypsum.org

GSA	General Services Administration http://www.gsa.gov
HI	Hydraulic Institute http://www.pumps.org
HPVA	Hardwood Plywood & Veneer Association http://www.hpva.org
ICBO	International Conference of Building Officials http://www.icbo.org
ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
ICAC	Institute of Clean Air Companies http://www.icac.com
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org
IMSA	International Municipal Signal Association http://www.imsasafety.org
IPCEA	Insulated Power Cable Engineers Association
NBMA	Metal Buildings Manufacturers Association http://www.mbma.com
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry Inc. http://www.mss-hq.com
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
NAPHCC	Plumbing-Heating-Cooling Contractors Association http://www.phccweb.org.org
NBS	National Bureau of Standards See – NIST
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors http://www.nationboard.org
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association http://www.nema.org
NFPA	National Fire Protection Association http://www.nfpa.org

NHLA	National Hardwood Lumber Association http://www.natlhardwood.org
NIH	National Institute of Health http://www.nih.gov
NIST	National Institute of Standards and Technology http://www.nist.gov
NLMA	Northeastern Lumber Manufacturers Association, Inc. http://www.nelma.org
NPA	National Particleboard Association 18928 Premiere Court Gaithersburg, MD 20879 (301) 670-0604
NSF	National Sanitation Foundation http://www.nsf.org
NWWDA	Window and Door Manufacturers Association http://www.nwwda.org
OSHA	Occupational Safety and Health Administration Department of Labor http://www.osha.gov
PCA	Portland Cement Association http://www.portcement.org
PCI	Precast Prestressed Concrete Institute http://www.pci.org
PPI	The Plastic Pipe Institute http://www.plasticpipe.org
PEI	Porcelain Enamel Institute, Inc. http://www.porcelainenamel.com
PTI	Post-Tensioning Institute http://www.post-tensioning.org
RFCI	The Resilient Floor Covering Institute http://www.rfci.com
RIS	Redwood Inspection Service See – CRA
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org
SCMA	Southern Cypress Manufacturers Association http://www.cypressinfo.org

SDI	Steel Door Institute http://www.steeldoor.org
IGMA	Insulating Glass Manufacturers Alliance http://www.igmaonline.org
SJI	Steel Joist Institute http://www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org
SSPC	The Society for Protective Coatings http://www.sspc.org
STI	Steel Tank Institute http://www.steeltank.com
SWI	Steel Window Institute http://www.steelwindows.com
TCA	Tile Council of America, Inc. http://www.tileusa.com
TEMA	Tubular Exchange Manufacturers Association http://www.tema.org
TPI	Truss Plate Institute, Inc. 583 D'Onofrio Drive; Suite 200 Madison, WI 53719 (608) 833-5900
UBC	The Uniform Building Code See ICBO
UL	Underwriters' Laboratories Incorporated http://www.ul.com
ULC	Underwriters' Laboratories of Canada http://www.ulc.ca
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns Road, P.O. Box 23145 Portland, OR 97223 (503) 639-0651
WRCLA	Western Red Cedar Lumber Association P.O. Box 120786 New Brighton, MN 55112 (612) 633-4334
WWPA	Western Wood Products Association http://www.wwpa.org

DEFENDER LODGE ENTRY AND SERVICE YARD UPGRADE
Palo Alto, California
VA Palo Alto Health Care System

DVA Project No. 640-14-127

--- E N D ---

**SECTION 01 45 29
TESTING LABORATORY SERVICES**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.02 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- A. American Association of State Highway and Transportation Officials (AASHTO):
 - T027-11 Sieve Analysis of Fine and Coarse Aggregates
 - T096-02 (2010) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T099-10 The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (2011) Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-11 Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
 - T191-11 Density of Soil In-Place by the Sand-Cone Method
- B. American Concrete Institute (ACI):
 - 506.4R-94 (R2004) Guide for the Evaluation of Shotcrete
- C. American Society for Testing and Materials (ASTM):
 - A325-10e1 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A370-12a Definitions for Mechanical Testing of Steel Products
 - A416/A416M-12a Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
 - A490-12 Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - C31/C31M-12 Making and Curing Concrete Test Specimens in the Field
 - C33-13 Concrete Aggregates
 - C39/C39M-12a Compressive Strength of Cylindrical Concrete Specimens
 - C109/C109M-12 Compressive Strength of Hydraulic Cement Mortars
 - C138/C138M-13 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
 - C140-13 Sampling and Testing Concrete Masonry Units and Related Units
 - C143/C143M-12 Slump of Hydraulic Cement Concrete
 - C172/C172M-10 Sampling Freshly Mixed Concrete
 - C173/C173M-12 Air Content of freshly Mixed Concrete by the Volumetric Method

C330/C330M-09	Lightweight Aggregates for Structural Concrete
C567/C567M-11	Density Structural Lightweight Concrete
C780-12a	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-13	Sampling and Testing Grout
C1064/C1064M-12	Freshly Mixed Portland Cement Concrete
C1077-13a	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-12	Compressive Strength of Masonry Prisms
D698-12	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143/D1143M-07(2013)	Piles Under Static Axial Compressive Load
D1188-07e1	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-07	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-12	Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166-06	Unconfined Compressive Strength of Cohesive Soil
D2167-08	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-10	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2974-07a	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-11	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-12a	Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material
E94-04(2010)	Radiographic Testing
E164-13	Ultrasonic Contact Examination of Weldments
E329-11c	Agencies Engaged in Construction Inspection and/or Testing
E543-13	Agencies Performing Non-Destructive Testing
E709-08	Guide for Magnetic Particle Examination
E1155-96(2008)	Determining FF Floor Flatness and FL Floor Levelness Numbers

- D. American Welding Society (AWS):
D1.1/D1.1M-10..... Structural Welding Code-Steel

1.03 REQUIREMENTS

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E 329, C 1077, D 3666, D3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Contracting Officer's

Representative (COR). When it appears materials furnished, or work performed by Contractor fails to meet construction contract requirements, Testing Laboratory shall direct attention of COR to such failure.

- C. Written Reports: Testing laboratory shall submit test reports to COR, Contractor, unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 EARTHWORK

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:
 - 1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
 - 2. Provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
 - 3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.
- B. Testing Compaction:
 - 1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D1557.
 - 2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556, or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.
 - a. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - b. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - c. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
 - 3. Testing Materials: Test suitability of on-site and off-site borrow as directed by the COR.

3.02 FOUNDATION CAISSONS

- A. Concrete Testing: Test concrete including materials for concrete as required in Article, CONCRETE of this section, except make two test cylinders for each day's placement of concrete.
- B. Maintain a record of concrete used in each caisson. Compare records with calculated volumes.
- C. Inspect percussion hole in bottom of each caisson to determine that material is capable of supporting design load.
- D. Inspect sides and bottom of each caisson for compliance with contract documents.
- E. Submit a certified "Caisson Field Record" for each caisson, recording actual elevation at bottom of shaft; final center line location of top; variation of shaft from plumb; results of all tests performed; actual allowable bearing capacity of bottom; depth of socket into rock; levelness of bottom; seepage of water; still water level (if allowed to flood); variation of shaft (from dimensions shown); location and size of reinforcement, and evidence of seams, voids, or channels below the bottom. Verify the actual bearing capacity of the rock strata by the use of a calibrated penetrometer or other acceptable method.

3.03 SITE WORK CONCRETE

- A. Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.04 CONCRETE

- A. Batch Plant Inspection and Materials Testing:
 - 1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of Resident Engineer with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by Resident Engineer.
 - 2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to Resident Engineer.
 - 3. Sample and test mix ingredients as necessary to insure compliance with specifications.
 - 4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
 - 5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.
- B. Field Inspection and Materials Testing:
 - 1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
 - 2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed

- will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. // After good concrete quality control has been established and maintained as determined by Resident Engineer make three cylinders for each 80 m³ (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. // Label each cylinder with an identification number. Resident Engineer may require additional cylinders to be molded and cured under job conditions.
 4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
 5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
 6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
 7. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
 8. Verify that specified mixing has been accomplished.
 9. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
 10. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
 11. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
 12. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
 13. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
 14. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
 15. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
 16. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
 17. Other inspections:

- a. Grouting under base plates.
- b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- C. Laboratory Tests of Field Samples:
 - 1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by Resident Engineer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
 - 2. Furnish certified compression test reports (duplicate) to Resident Engineer. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weather conditions during placing.
 - f. Temperature of concrete in each test cylinder when test cylinder was molded.
 - g. Maximum and minimum ambient temperature during placing.
 - h. Ambient temperature when concrete sample in test cylinder was taken.
 - i. Date delivered to laboratory and date tested.

3.05 REINFORCEMENT

- A. Review mill test reports furnished by Contractor.
- B. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).
- C. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.
- D. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.
- E. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.06 MASONRY

- A. Mortar Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
 - 2. Two tests during first week of operation; one test per week after initial test until masonry completion.
- B. Grout Tests:
 - 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 230 m² (2500 square feet) of masonry.

- C. Masonry Unit Tests:
 - 1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 460 m² (5000 square feet) of wall area.
- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m² (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

3.07 STRUCTURAL STEEL

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.
- B. Prefabrication Inspection:
 - 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
 - 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
 - 3. Approve welder qualifications by certification or retesting.
 - 4. Approve procedure for control of distortion and shrinkage stresses.
 - 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.
- C. Fabrication and Erection:
 - 1. Weld Inspection:
 - a. Inspect welding equipment for capacity, maintenance and working condition.
 - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
 - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
 - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
 - e. Measure 25 percent of fillet welds.
 - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
 - i. 20 percent of all shear plate fillet welds at random, final pass only.
 - ii. 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - iii. 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - iv. 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - v. 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
 - g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
 - h. Verify that correction of rejected welds are made in accordance with AWS D1.1.

- i. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
 - 2. Bolt Inspection:
 - a. Inspect high-strength bolting in accordance with requirements of the CBC Section 1701, "Special Inspections". Perform QA inspection tasks listed in ANSI/AISC 341, Appendix Q, Section Q5.3, "Inspection of Bolting".
 - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
 - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
 - e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
 - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COR.

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
 - 1. Adversely effect human health or welfare,
 - 2. Unfavorably alter ecological balances of importance to human life,
 - 3. Effect other species of importance to humankind, or;
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

- C. Definitions of Pollutants:
 - 1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
 - 2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
 - 3. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
 - 4. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
 - 5. Sanitary Wastes:
 - a. Sewage: Domestic sanitary sewage and human and animal waste.
 - b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.02 QUALITY CONTROL

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.

- B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.03 REFERENCES

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

- B. U.S. National Archives and Records Administration (NARA):
33 CFR 328..... Definitions

1.04 SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Contracting Officer's Representative (COR) to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the COR and the Contracting Officer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
 - b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
 - c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
 - d. Description of the Contractor's environmental protection personnel training program.
 - e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
 - f. Methods for protection of features to be preserved within authorized work areas including air and water quality and cultural resources.
 - g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
 - h. Permits, licenses, and the location of the solid waste disposal area.
 - i. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - j. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas.
- B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.05 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.
- B. Protection of Land Resources:
1. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.

2. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 3. Handle discarded materials other than those included in the solid waste category as directed by the COR.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
- D. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of California and California Air Pollution Statute, Rule, or Regulation and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
 3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- E. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only during business-off hours (exact hours to be coordinated with COR) unless otherwise permitted by COR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
 - a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

EARTHMOVING

MATERIALS HANDLING

TEMPORARY ENVIRONMENTAL CONTROLS

FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS,	80	PNEUMATIC TOOLS	80
STATIONARY PUMPS	75	BLASTING	//--//
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

- b. Use shields or other physical barriers to restrict noise transmission.
 - c. Provide soundproof housings or enclosures for noise-producing machinery.
 - d. Use efficient silencers on equipment air intakes.
 - e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - f. Line hoppers and storage bins with sound deadening material.
 - g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the COR noting any problems and the alternatives for mitigating actions.
- F. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
- G. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

--- E N D ---

**SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
 - 1. Waste Management Plan development and implementation.
 - 2. Techniques to minimize waste generation.
 - 3. Sorting and separating of waste materials.
 - 4. Salvage of existing materials and items for reuse or resale.
 - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
 - 1. Soil.
 - 2. Inerts (eg, concrete, masonry and asphalt).
 - 3. Clean dimensional wood and palette wood.
 - 4. Green waste (biodegradable landscaping materials).
 - 5. Engineered wood products (plywood, particle board and I-joists, etc).
 - 6. Metal products (eg, steel, wire, beverage containers, copper, etc).
 - 7. Cardboard, paper and packaging.
 - 8. Bitumen roofing materials.
 - 9. Plastics (eg, ABS, PVC).
 - 10. Carpet and/or pad.
 - 11. Gypsum board.
 - 12. Insulation.
 - 13. Paint.
 - 14. Fluorescent lamps.

1.02 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 02 41 00, DEMOLITION.

1.03 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
 - 1. Excess or unusable construction materials.
 - 2. Packaging used for construction products.
 - 3. Poor planning and/or layout.
 - 4. Construction error.
 - 5. Over ordering.

6. Weather damage.
 7. Contamination.
 8. Mishandling.
 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
 - C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 75 percent.
 - D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
 - E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.cwm.wbdg.org> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
 - F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.
 - G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
 - H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.04 TERMINOLOGY

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.

- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.
- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
 - 1. On-site Recycling – Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
 - 2. Off-site Recycling – Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.05 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

- B. Prepare and submit to the Contracting Officer's Representative (COR) a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
 - 1. Procedures to be used for debris management.
 - 2. Techniques to be used to minimize waste generation.
 - 3. Analysis of the estimated job site waste to be generated:
 - a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.
 - 4. Detailed description of the Means/Methods to be used for material handling.
 - a. On site: Material separation, storage, protection where applicable.
 - b. Off site: Transportation means and destination. Include list of materials.
 - i. Description of materials to be site-separated and self-hauled to designated facilities.
 - ii. Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - c. The names and locations of mixed debris reuse and recycling facilities or sites.
 - d. The names and locations of trash disposal landfill facilities or sites.
 - e. Documentation that the facilities or sites are approved to receive the materials.
- C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.
- B. U.S. Green Building Council (USGBC):
LEED Green Building Rating System for New Construction

1.07 RECORDS

- A. Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.
- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 – EXECUTION

3.01 COLLECTION

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.02 DISPOSAL

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.03 REPORT

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

--- E N D ---

**SECTION 02 41 00
DEMOLITION**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies demolition and removal of utilities, interior finishes, casework, electrical system, and other items for the installation of the new construction.

1.02 RELATED WORK

- A. Safety Requirements: Section 01 35 26, SAFETY REQUIREMENTS.
- B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Construction Waste Management: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- F. Infectious Control: Section 01 35 26, SAFETY REQUIREMENTS, Article 1.12, INFECTION CONTROL.
- G. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.

1.03 PROTECTION

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

- E. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
 - 1. No wall or part of wall shall be permitted to fall outwardly from structures.
 - 2. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - 3. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- F. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the Contracting Officer's Representative (COR). The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.
- G. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- H. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.08 INFECTION PREVENTION MEASURES.

1.04 UTILITY SERVICES

- A. Demolish and remove outside utility service lines shown to be removed.
- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 DEMOLITION

- A. Do not start demolition work before the installation of construction barricade.
- B. Perform demolition as much as possible with small tools.
- C. Schedule demolition work with COR so that the continuous operations of the adjoining occupied spaces are not jeopardized.
- D. Completely demolish and remove portions of buildings and structures, including all appurtenances related or connected thereto, as noted below:
 - 1. As required for installation of new utility service lines.

- E. Debris, including concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- F. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.
- G. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer's Representative. When Utility lines are encountered that are not indicated on the drawings, the Contracting Officer's Representative shall be notified prior to further work in that area.

3.02 CLEAN-UP

- A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COR. Clean-up shall include off the Medical Center disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

--- E N D ---

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies cast-in-place structural concrete and materials and mixes for other concrete.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN:

- A. Testing agency retained and reimbursed by the Contractor and approved by Resident Engineer.
- B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. Accompany request for approval of testing agency with a copy of Report of Latest Inspection of Laboratory Facilities by CCRL.
- C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

1.4 TOLERANCES:

- A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch). Tolerance of thickness of beams more than 300 mm (12 inch) but less than 900 mm (3 feet) is +20 mm (+3/4 inch) and -10 mm (-3/8 inch).

1.5 REGULATORY REQUIREMENTS:

- A. ACI SP-66 - ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 301 - Standard Specifications for Structural Concrete.

1.6 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings: Reinforcing steel: Complete shop drawings

- C. Mill Test Reports:
 - 1. Reinforcing Steel.
 - 2. Cement.
- D. Manufacturer's Certificates:
 - 1. Chemical admixtures, including chloride ion content.
 - 2. Waterproof paper for curing concrete.
 - 3. Liquid membrane-forming compounds for curing concrete.
 - 4. Non-shrinking grout.
 - 5. Liquid hardener.
 - 6. Waterstops.
 - 7. Expansion joint filler.
 - 8. Adhesive binder.
- E. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology and copy of report of latest CCRL, Inspection of Laboratory.
- F. Test Report for Concrete Mix Designs: Trial mixes including water-cement ratio curves, concrete mix ingredients, and admixtures.

1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.
- B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 300 mm (1 foot) above ground. Store bulk cement in separate suitable bins.
- C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

1.09 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
 - 117-10.....Tolerances for Concrete Construction and
Materials
 - 211.1-91(R2009).....Selecting Proportions for Normal, Heavyweight,
and Mass Concrete

- 211.2-98(R2004).....Selecting Proportions for Structural Lightweight
Concrete
- 214R-02.....Evaluation of Strength Test Results of Concrete
- 301-10.....Structural Concrete
- 304R-00(R2009).....Guide for Measuring, Mixing, Transporting, and
Placing Concrete
- 305R-10.....Hot Weather Concreting
- 306R-10.....Cold Weather Concreting
- 308R-01(R2008).....Standard Practice for Curing Concrete
- 309R-05.....Guide for Consolidation of Concrete
- 318-08.....Building Code Requirements for Reinforced
Concrete and Commentary
- 347-04.....Guide to Formwork for Concrete
- SP-66-04.....ACI Detailing Manual
- C. American National Standards Institute and American Hardboard Association
(ANSI/AHA):
 - A135.4-2004.....Basic Hardboard
- D. American Society for Testing and Materials (ASTM):
 - A82/A82M-07.....Steel Wire, Plain, for Concrete Reinforcement
 - A185/185M-07.....Steel Welded Wire Fabric, Plain, for Concrete
Reinforcement
 - A615/A615M-09.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement
 - A653/A653M-09.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-
Iron Alloy-Coated (Galvannealed) by the Hot-Dip
Process
 - A706/A706M-09.....Low-Alloy Steel Deformed and Plain Bars for
Concrete Reinforcement
 - C31/C31M-09.....Making and Curing Concrete Test Specimens in the
field
 - C33-08.....Concrete Aggregates
 - C39/C39M-09.....Compressive Strength of Cylindrical Concrete
Specimens
 - C94/C94M-09.....Ready-Mixed Concrete
 - C143/C143M-10.....Slump of Hydraulic Cement Concrete
 - C150-09.....Portland Cement
 - C171-07.....Sheet Materials for Curing Concrete
 - C172-08.....Sampling Freshly Mixed Concrete
 - C192/C192M-07.....Making and Curing Concrete Test Specimens in the
Laboratory

- C231-09.....Air Content of Freshly Mixed Concrete by the Pressure Method
- C309-07.....Liquid Membrane-Forming Compounds for Curing Concrete
- C330-09.....Lightweight Aggregates for Structural Concrete
- C494/C494M-10.....Chemical Admixtures for Concrete
- C881/C881M-02.....Epoxy-Resin-Base Bonding Systems for Concrete
- C1107/1107M-08.....Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
- C1315-08.....Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
- D6-95(R2006).....Loss on Heating of Oil and Asphaltic Compounds
- D297-93(R2006).....Rubber Products-Chemical Analysis
- D1751-04(R2008).....Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- D4397-09.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
- E. American Welding Society (AWS):
 - D1.4/D1.4M-11.....Structural Welding Code - Reinforcing Steel
- F. Concrete Reinforcing Steel Institute (CRSI):
 - Handbook 2008
- H. U. S. Department of Commerce Product Standard (PS):
 - PS 1.....Construction and Industrial Plywood
 - PS 20.....American Softwood Lumber
- I. U. S. Army Corps of Engineers Handbook for Concrete and Cement:
 - CRD C513.....Rubber Waterstops
 - CRD C572.....Polyvinyl Chloride Waterstops

PART 2 - PRODUCTS:

2.1 MATERIALS:

- A. Portland Cement: ASTM C150 Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalies, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33.
 - 1. Size 67 or Size 467 may be used for footings and walls over 300 mm (12 inches) thick.
 - 2. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 7.

3. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.
- D. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150 μ m (No. 100) sieve.
- E. Mixing Water: Fresh, clean, and potable.
- F. Admixtures:
 1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
 2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
 3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
 4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
 5. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
 6. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.
- G. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).
- H. Reinforcing Steel: ASTM A615, grade as shown.
- I. Welded Wire Fabric: ASTM A185.
- J. Reinforcing Bars to be Welded: ASTM A706.
- K. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.
- L. Expansion Joint Filler: ASTM D1751.
- M. Sheet Materials for Curing Concrete: ASTM C171.
- N. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.

- O. Abrasive Aggregate: Aluminum oxide grains or emery grits.
- P. Non-Shrink Grout:
 - 1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 35 MPa (7000 psi) at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 1200 mm x 1200 mm (4 foot by 4 foot) base plate.
 - 2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 450 mm x 900 mm (18 inch by 36 inch) base plate.
- Q. Adhesive Binder: ASTM C881.
 - 1. Polyvinyl Chloride Waterstop: CRD C572.
 - 2. Rubber Waterstops: CRD C513.
 - 3. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).
 - 4. Epoxy Joint Filler: Two component, 100 percent solids compound, with a minimum shore D hardness of 50.
 - 5. Bonding Admixture: Non-rewettable, polymer modified, bonding compound.
 - 6. Architectural Concrete: For areas designated as architectural concrete on the Contract Documents, use colored cements and specially selected aggregates as necessary to produce a concrete of a color and finish which exactly matches the designated sample panel.

2.2 CONCRETE MIXES:

- A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
 - 1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
 - 2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including fly ash, cement, admixtures, weight of fine and coarse aggregate per m³ (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement ratio, and consistency of each cylinder in terms of slump. include dry unit weight of lightweight structural concrete.

3. Prepare a curve showing relationship between water-cement ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
 4. If the field experience method is used, submit complete standard deviation analysis.
- B. Cement and Fly Ash Testing: Submit certificate verifying conformance with specifications initially with mix design and for each truck load of cement delivered from source. Notify Resident Engineer immediately when change in source is anticipated. Prior to beginning trial mixes submit to the Resident Engineer the following representative samples of material to be used, properly identified source and project description and number, type of testing (complete chemical and physical), suitably packaged for shipment, and addressed as specified. Allow 60 calendar days for test results after submittal of sample.
1. Portland cement - 3.5 kg (8 pounds):
 2. Fly ash - 2.25 kg (5 pounds):
 - a. Address -Waterways Experiment Station (WES)
 - b. 3909 Halls Ferry Road
 - c. Vicksburg, MS 39180-6199
 - d. ATTN: Engineering Materials Group
- C. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of Resident Engineer or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement , providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. Resident Engineer may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and approval of design mix.
- D. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Use Fly Ash as an admixture with 20% replacement by weight in all structural work.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) ^{1,3}	375 (630)	0.45	385 (650)	0.40
30 (4000) ^{1,3}	325 (550)	0.55	340 (570)	0.50

25 (3000) ^{1,3}	280 (470)	0.65	290 (490)	0.55
25 (3000) ^{1,2}	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
 2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
 3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.
- E. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP, MM (INCHES)*

Type of Construction	Normal Weight Concrete	Lightweight Structural Concrete
Reinforced Footings and Substructure Walls	75mm (3 inches)	75 mm (3 inches)

- F. Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 50 mm to 75 mm (2 inches to 3 inches), and 75 mm to 100 mm (3 inches to 4 inches) for lightweight concrete. This should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.
- G. High early strength concrete, made with Type III cement or Type I cement plus non-corrosive accelerator, shall have a 7-day compressive strength equal to specified minimum 28-day compressive strength for concrete type specified made with standard Portland cement.
- H. Enforcing Strength Requirements: Test as specified in Section 01 45 29, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance

with ACI 214. Should strengths shown by test specimens fall below required values, Resident Engineer may require any one or any combination of the following corrective actions, at no additional cost to the Government:

1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
2. Require additional curing and protection.
3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, Resident Engineer may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, Resident Engineer may order load tests, made by Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the Resident Engineer.

2.3 BATCHING AND MIXING:

- A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by Resident Engineer. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38°C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)
-17 degrees C to -1.1 degrees C (0 degrees to 30 degrees F.)	21 degrees C (70 degrees F.)

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the Resident Engineer for consultation during batching, mixing, and

placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise Resident Engineer.

PART 3 - EXECUTION

3.1 FORMWORK:

- A. General: Design in accordance with ACI 347 is the responsibility of the Contractor. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.

3.2 PLACING REINFORCEMENT:

- A. General: Details of concrete reinforcement in accordance with ACI 318 unless otherwise shown.
- B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.
 - 1. Place reinforcing bars accurately and tie securely at intersections and splices with 1.6 mm (16 gauge) black annealed wire. Use epoxy-coated tie wire with epoxy-coated reinforcing. Secure reinforcing bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with formwork shall be made of plastic in areas that will be exposed when building is occupied. Type, number, and spacing of supports conform to ACI 318. Where concrete slabs are placed on ground, use concrete blocks or other non-corrodible material of proper height, for support of reinforcement. Use of brick or stone supports will not be permitted.
 - 2. Lap welded wire fabric at least 1 1/2 mesh panels plus end extension of wires not less than 300 mm (12 inches) in structural slabs. Lap welded wire fabric at least 1/2 mesh panels plus end extension of wires not less than 150 mm (6 inches) in slabs on grade.
 - 3. Splice column steel at no points other than at footings and floor levels unless otherwise shown.
- C. Spacing: Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.
- D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:

1. Lap splices: Do not use lap splices for bars larger than Number 36 (Number 11). Minimum lengths of lap as shown.
- E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete, except when approved by Resident Engineer.
- F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that will reduce bond.
- G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

3.3 CONSTRUCTION JOINTS:

- A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 24,000 mm (80 feet) in any horizontal direction, except slabs on grade which shall have construction joints shown. Allow 48 hours to elapse between pouring adjacent sections unless this requirement is waived by Resident Engineer.

3.6 EXPANSION JOINTS:

- A. Clean expansion joint surfaces before installing premolded filler and placing adjacent concrete.

3.7 PLACING CONCRETE:

- A. Preparation:
 1. Remove hardened concrete, wood chips, shavings and other debris from forms.
 2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
 3. Have forms and reinforcement inspected and approved by Resident Engineer before depositing concrete.
 4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.
- B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.
 1. Preparing surface for applied topping:
 - a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.

- b. Broom clean and keep base slab wet for at least four hours before topping is applied.
 - c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.
- C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete subject to approval of Resident Engineer.
- D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.
1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 hours.
 2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
 3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (superplasticizer) or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
 4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
 5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after it's initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
- E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of

reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.

1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

3.8 HOT WEATHER:

- A. Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

3.9 COLD WEATHER:

- A. Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

3.10 PROTECTION AND CURING:

- A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by Resident Engineer.
 1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 10m²/L (400 square feet per gallon) on steel troweled surfaces and 7.5m²/L (300 square feet per gallon) on floated or broomed surfaces for the curing/sealing compound.
 2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and

overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.

3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

3.11 CONCRETE FINISHES:

A. Slab Finishes:

1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to Resident Engineer and floor consultant for evaluation and recommendations for subsequent placements.
2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish initial grade during strike-off, unless Resident Engineer determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.
3. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
4. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.

5. Immediately following screeding, and before any bleed water appears, use a 3000 mm (10 foot) wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 6 mm (1/4 inch) indentation.
7. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by Resident Engineer from sample panel.

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**SECTION 04 05 13
MASONRY MORTARING**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section specifies mortar materials and mixes.

1.02 RELATED WORK

- A. Mortar used in Section:
 - 1. Section 04 05 16, MASONRY GROUTING.
 - 2. Section 04 20 00, UNIT MASONRY.
- B. Mortar Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
 - 1. Indicating that following items meet specifications:
 - a. Portland cement.
 - b. Masonry cement.
 - c. Mortar cement.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
- C. Laboratory Test Reports:
 - 1. Mortar, each type.
 - 2. Admixtures.
- D. Manufacturer's Literature and Data:
 - 1. Cement, each kind.
 - 2. Hydrated lime.
 - 3. Admixtures.
 - 4. Liquid acrylic resin.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.05 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.

- B. American Society for Testing and Materials (ASTM):
 - C40-04 Organic Impurities in Fine Aggregates for Concrete
 - C91-05 Masonry Cement
 - C109-08 Compressive Strength of Hydraulic Cement Mortars
(Using 2-in. or 50-MM Cube Specimens)
 - C144-04 Aggregate for Masonry Mortar
 - C150-09 Portland Cement
 - C207-06 Hydrated Lime for Masonry Purposes
 - C270-10 Mortar for Unit Masonry
 - C307-03(R2008) Tensile Strength of Chemical - Resistant Mortar, Grouts,
and Monolithic Surfacing
 - C321-00(R2005) Bond Strength of Chemical-Resistant Mortars
 - C348-08 Flexural Strength of Hydraulic Cement Mortars
 - C595-10 Blended Hydraulic Cement
 - C780-10 Preconstruction and Construction Evaluation of Mortars
for Plain and Reinforced Unit Masonry
 - C979-10 Pigments for Integrally Colored Concrete
 - C1329-05 Mortar Cement

PART 2 - PRODUCTS

2.01 HYDRATED LIME

- A. ASTM C207, Type S.

2.02 AGGREGATE FOR MASONRY MORTAR

- A. ASTM C144 and as follows:
 - 1. Light colored sand for mortar for laying face brick.

2.03 BLENDED HYDRAULIC CEMENT

- A. ASTM C595, Type IS, IP.

2.04 MASONRY CEMENT

- A. ASTM C91. Type N, S, or M.

2.05 MORTAR CEMENT

- A. ASTM C1329, Type N, S or M.

2.06 PORTLAND CEMENT

- A. ASTM C150, Type I.

2.07 LIQUID ACRYLIC RESIN

- A. A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.08 WATER

- A. Potable, free of substances that are detrimental to mortar, masonry, and metal.

2.09 MASONRY MORTAR

- A. Conform to ASTM C270.
- B. Admixtures:
 - 1. Do not use mortar admixtures, unless approved by Resident Engineer.
 - 2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
 - 3. Do not use antifreeze compounds.
- C. Colored Mortar:
 - 1. Maintain uniform mortar color for exposed work throughout.
 - 2. Match mortar color in approved sample 3. Color of mortar for exposed work in alteration work to match color of existing mortar unless specified otherwise in section 09 06 00, SCHEDULE FOR FINISHES.
- D. Color Admixtures:
 - 1. Proportion as specified by manufacturer.
 - 2. For color, see Section 09 06 00, SCHEDULE FOR FINISHES.

2.10 COLOR ADMIXTURE

- A. Pigments: ASTM C979.
- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION

3.01 MIXING

- A. Mix in a mechanically operated mortar mixer.
 - 1. Mix mortar for at least three minutes but not more than five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
- D. Mortar that has stiffened because of loss of water through evaporations:
 - 1. Re-tempered by adding water to restore to proper consistency and workability.
 - 2. Discard mortar that has reached its initial set or has not been used within two hours.

3.02 MORTAR USE LOCATION

- A. Use Type S mortar for masonry containing vertical reinforcing bars and engineered reinforced unit masonry work.
- B. For brick veneer over frame back up walls, use Type N portland cement-lime mortar or Type S masonry cement or mortar cement mortar.

--- E N D ---

**SECTION 04 05 16
MASONRY GROUTING**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section specifies grout materials and mixes.

1.02 RELATED WORK

- A. Grout used in Section:
 - 1. Section 04 20 00, UNIT MASONRY.

1.03 TESTS

- A. Test grout and materials specified.
- B. Certified test reports.
- C. Identify materials by type, brand name and manufacturer or by origin.
- D. Do not use materials until laboratory test reports are approved by Resident Engineer.
- E. After tests have been made and materials approved, do not change without additional test and approval of Resident Engineer.
- F. Testing:
 - 1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
 - 2. Grout:
 - a. Test for compressive strength; ASTM C1019.
 - b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.
 - 3. Cement:
 - a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
 - b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
 - 4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
 - 1. Indicating that following items meet specifications:
 - a. Portland cement.
 - b. Masonry cement.
 - c. Grout.
 - d. Hydrated lime.
 - e. Fine aggregate (sand).
 - f. Color admixture.

- C. Laboratory Test Reports:
 - 1. Grout, each type.
 - 2. Admixtures.

- D. Manufacturer's Literature and Data:
 - 1. Cement, each kind.
 - 2. Hydrated lime.
 - 3. Admixtures.
 - 4. Liquid acrylic resin.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.

- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-04 Organic Impurities in Fine Aggregates for Concrete
 - C91-05 Masonry Cement
 - C150-09 Portland Cement
 - C207-06 Hydrated Lime for Masonry Purposes
 - C404-07 Aggregate for Masonry Grout
 - C476-10 Grout for Masonry
 - C595-10 Blended Hydraulic Cement
 - C979-10 Pigments for Integrally Colored Concrete
 - C1019-11 Sampling and Testing Grout

PART 2 - PRODUCTS

2.01 HYDRATED LIME

- A. ASTM C207, Type S.

2.02 AGGREGATE FOR MASONRY GROUT

- A. ASTM C404, Size 8.

2.03 BLENDED HYDRAULIC CEMENT

- A. ASTM C595, Type IS, IP.

2.04 MASONRY CEMENT

- A. ASTM C91. Type S.

2.05 PORTLAND CEMENT

- A. ASTM C150, Type I.

2.06 LIQUID ACRYLIC RESIN

- A. A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.07 WATER

- A. Potable, free of substances that are detrimental to grout, masonry, and metal.

2.08 GROUT

- A. Conform to ASTM C476 except as specified.
- B. Grout type proportioned by volume as follows:
 - 1. Fine Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - 2. Coarse Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - d. Coarse aggregate: one to two times sum of volumes of cement and lime used.
 - 3. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.

2.09 COLOR ADMIXTURE

- A. Pigments: ASTM C979.
- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION

3.01 MIXING

- A. Mix in a mechanically operated grout mixer.
 - 1. Mix grout for at least five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.02 GROUT USE LOCATIONS

- A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.

- B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).
- C. Do not use grout for filling bond beam or lintel units.

--- E N D ---

**SECTION 04 20 00
UNIT MASONRY**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies requirements for construction of masonry unit walls.

1.02 RELATED WORK

- A. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- B. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples:
1. Face brick, showing color and texture of bricks to match existing brick color and finish.
 2. Concrete masonry units, showing color and texture of bricks to match existing brick color and finish.
 3. Anchors, and ties, one each.
- C. Shop Drawings:
1. Special masonry shapes.
 2. Drawings, showing reinforcement, applicable dimensions and methods of hanging soffit or lintel masonry and reinforcing masonry for embedment of anchors for hung fixtures.
 3. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Comply with ACI 315. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.
- D. Certificates:
1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
 2. Indicating that the following items meet specification requirements:
 - a. Face brick.
 - b. Solid and load-bearing concrete masonry units.
 3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.
- E. Manufacturer's Literature and Data:
1. Anchors, ties, and reinforcement.
 2. Reinforcing bars.

1.04 WARRANTY

- A. Warrant exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be five years.

1.05 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A951-06..... Steel Wire for Masonry Joint Reinforcement.
 - A615/A615M-09 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - A675/A675M-03(R2009) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
 - C34-03 Structural Clay Load-Bearing Wall Tile
 - C55-09 Concrete Building Brick
 - C56-10 Structural Clay Non-Load-Bearing Tile
 - C62-10 Building Brick (Solid Masonry Units Made From Clay or Shale)
 - C67-09 Sampling and Testing Brick and Structural Clay Tile
 - C90-11 Load-Bearing Concrete Masonry Units
 - C126-10 Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
 - C216-10 Facing Brick (Solid Masonry Units Made From Clay or Shale)
 - C476-10 Standard Specification for Grout for Masonry
 - C612-10 Mineral Fiber Block and Board Thermal Insulation
 - C744-11 Prefaced Concrete and Calcium Silicate Masonry Units.
 - D1056-07 Flexible Cellular Materials - Sponge or Expanded Rubber
 - D2000-08 Rubber Products in Automotive Applications
 - D2240-05(R2010) Rubber Property - Durometer Hardness
 - D3574-08 Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams
 - F1667-11 Fasteners: Nails, Spikes and Staples
- C. Masonry Industry Council: Hot and Cold Weather Masonry Construction Manual-98 (R2000).
- D. American Welding Society (AWS):
 - D1.4-11 Structural Welding Code – Reinforcing Steel
- E. Federal Specifications (FS):
 - FF-S-107C-00 Screws, Tapping and Drive
- F. Brick Industry Association - Technical Notes on Brick Construction (BIA):
 - 11-2001 Guide Specifications for Brick Masonry, Part I
 - 11A-1988 Guide Specifications for Brick Masonry, Part II
 - 11B-1988 Guide Specifications for Brick Masonry, Part III Execution
 - 11C-1998 Guide Specification for Brick Masonry Engineered Brick Masonry, Part IV

11D-1988 Guide Specifications for Brick Masonry Engineered Brick
Masonry, Part IV continued

- G. Masonry Standards Joint Committee; Specifications for Masonry Structures TMS 602-08/ACI 530.1-08/ASCE 6-08 (2008 MSJC Book Version TMS-0402-08).

PART 2 - PRODUCTS

2.01 BRICK

- A. Face Brick:
1. ASTM C216, Grade SW, Type FBS.
 2. Brick when tested in accordance with ASTM C67: Classified slightly efflorescent or better.
 - a. Size: Modular.
- B. Building Brick: ASTM C62, Grade MW for backup and interior work; Grade SW where in contact with earth.

2.02 CONCRETE MASONRY UNITS

- A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
1. Unit Weight: Medium weight
 2. Sizes: Modular.
 3. For molded faces used as a finished surface, use concrete masonry units with uniform fine to medium surface texture unless specified otherwise.
 4. Use bullnose concrete masonry units at corners exposed in finished work with 25 mm (one inch) minimum radius rounded vertical exterior corners (bullnose units).

2.03 ANCHORS, TIES, AND REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.
- B. Dovetail Anchors:
1. Triangular wire dovetail anchor 100 mm (4 inch) wide formed of 4 mm (9 gage) stainless steel wire with stainless steel dovetail insert. Anchor length to extend at least 75 mm (3 inches) into masonry, 25 mm (1 inch) into 40 mm (1-1/2 inch) thick units.
 2. Form dovetail anchor slots from 0.6 mm (0.0239 inch) thick stainless steel (with felt or fiber filler).
- C. Individual ties:
1. Rectangular ties: Form from 5 mm (3/16 inch) diameter stainless steel rod to a rectangular shape not less than 50 mm (2 inches) wide by sufficient length for ends of ties to extend within 25 mm (1 inch) of each face of wall. Ties that are crimped to form drip are not permitted.

2.04 PREFORMED COMPRESSIBLE JOINT FILLER

- A. Thickness and depth to fill the joint as specified.
- B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.
- C. Non-Combustible Type: ASTM C612, Class 5, 1800 degrees F.

2.05 ACCESSORIES

- A. Weep Hole Wicks: Glass fiber ropes, 10 mm (3/8 inch) minimum diameter, 300 mm (12 inches) long.
- B. Box Board:
 - 1. Mineral Fiber Board: ASTM C612, Class 1.
 - 2. 25 mm (1 inch) thickness.
 - 3. Other spacing material having similar characteristics may be used subject to the Resident Engineer's approval.
- C. Masonry Cleaner:
 - 1. Detergent type cleaner selected for each type masonry used.
 - 2. Acid cleaners are not acceptable.
 - 3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.
- D. Fasteners:
 - 1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
 - 2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.
 - 3. SCREWS: FS-FF-S-107, TYPE A, AB, SF THREAD FORMING OR CUTTING

PART 3 - EXECUTION

3.01 JOB CONDITIONS

- A. Protection:
 - 1. Cover tops of walls with nonstaining waterproof covering, when work is not in progress. Secure to prevent wind blow off.
 - 2. On new work protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.
- B. Cold Weather Protection:
 - 1. Masonry may be laid in freezing weather when methods of protection are utilized.
 - 2. Comply with MSJC and "Hot and Cold Weather Masonry Construction Manual".

3.02 CONSTRUCTION TOLERANCES

- A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:
- B. Maximum variation from plumb:
 - 1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
 - 2. In 6000 mm (20 feet) - 10 mm (3/8 inch).
 - 3. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).
- C. Maximum variation from level:
 - 1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
 - 2. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).

- D. Maximum variation from linear building lines:
 - 1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
 - 2. In 12 000 mm (40 feet) or more - 19 mm (3/4 inch).
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
 - 1. Minus 6 mm (1/4 inch).
 - 2. Plus 13 mm (1/2 inch).
- F. Maximum variation in prepared opening dimensions:
 - 1. Accurate to minus 0 mm (0 inch).
 - 2. Plus 6 mm (1/4 inch).

3.03 INSTALLATION GENERAL

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in Paragraph, ANCHORAGE.
- C. Wall Openings:
 - 1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
 - 2. If items are not available when walls are built, prepare openings for subsequent installation.
- D. Tooling Joints:
 - 1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
 - 2. Tool while mortar is soft enough to be compressed into joints and not raked out.
 - 3. Finish joints in exterior face masonry work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
 - 4. Tool Exposed interior joints in finish work concave unless specified otherwise.
- E. Wall, Furring, and Partition Units:
 - 1. Lay out field units to provide for running bond of walls and partitions, with vertical joints in second course centering on first course units unless specified otherwise.
 - 2. Align head joints of alternate vertical courses.
 - 3. At sides of openings, balance head joints in each course on vertical center lines of openings.
 - 4. Use no piece shorter than 100 mm (4 inches) long.
 - 5. Use not less than 100 mm (4 inches) nominal thick masonry for free standing furring unless shown otherwise.
- F. Wetting and Wetting Test:
 - 1. Test and wet brick tile in accordance with BIA 11B.
 - 2. Do not wet concrete masonry units tile before laying.
- G. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.
- H. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.

- I. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction.

3.04 ANCHORAGE

- A. Masonry Facing to Backup and Cavity Wall Ties:
 1. Use individual ties for new work.
 2. Stagger ties in alternate courses, and space at 400 mm (16 inches) maximum vertically, and 600 mm (2 feet) horizontally.
 3. At openings, provide additional ties spaced not more than 900 mm (3 feet) apart vertically around perimeter of opening, and within 300 mm (12 inches) from edge of opening.
- B. Masonry Furring:
 1. Anchor masonry furring less than 100 mm (4 inches) nominal thick to masonry walls or to concrete with dovetail anchors.
 2. Space not over 600 mm (2 feet) on centers in both directions.

3.05 REINFORCEMENT

- A. Steel Reinforcing Bars:
 1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.
 2. Use grade 60 bars if not specified otherwise.
 3. Bond Beams:
 - a. Form Bond beams of load-bearing concrete masonry units filled with ASTM C476 grout and reinforced with 2-#15m (#5) reinforcing steel unless shown otherwise. Do not cut reinforcement.
 - b. Brake bond beams only at expansion joints and at control joints, if shown.
 4. Stack Bond:
 - a. Locate additional joint reinforcement in vertical and horizontal joints as shown.
 - b. Anchor vertical reinforcement into the foundation or wall or bond beam below and hold in place.
 - c. Provide temporary bracing for walls over 8 ft. tall until permanent horizontal bracing is completed.
 5. Grout openings:
 - a. Leave cleanout holes in double wythe walls during construction by omitting units at the base of one side of the wall.
 - b. Locate 75 mm x 75 mm (3 in. x 3 in.) min. clean-out holes at location of vertical reinforcement.
 - c. Keep grout space clean of mortar accumulation and sand debris. Clean the grout space every day using a high pressure jet stream of water, or compressed air, or industrial vacuum, or by laying wood strips on the metal ties as the wall is built. If wood strips are used, lift strips with wires as the wall progresses and before placing each succeeding course of wall ties.

3.06 BRICKWORK

- A. Lay clay brick in accordance with BIA Technical Note 11 series.

- B. Laying:
1. Lay brick to match bond of existing adjacent brick pattern.
 2. Maintain bond pattern throughout.
 3. Do not use brick smaller than half-brick at any angle, corner, break or jamb.
 4. Where length of cut brick is greater than one half but less than a whole brick, maintain the vertical joint location of such units.
 5. Lay exposed brickwork joints symmetrical about center lines of openings.
 6. Before starting work, lay facing brick on foundation wall and adjust bond to openings, angles, and corners.
 7. Build solid brickwork as required for anchorage of items.
- C. Joints:
1. Exterior and interior joint widths: Lay for three equal joints in 200 mm (eight inches) vertically, unless shown otherwise.
- D. Weep Holes:
1. Install weep holes at 600 mm (24 inches) on center in bottom of vertical joints of exterior masonry veneer or cavity wall facing over foundations, bond beams, and other water stops in the wall.
 2. Form weep holes using wicks made of mineral fiber insulation strips turned up 200 mm (8 inches) in cavity. Anchor top of strip to backup to securely hold in place.
 3. Install sand or pea gravel in cavity approximately 75 mm (3 inches) high between weep holes.
- E. Cavity Type Exterior Walls:
1. Keep air space clean of mortar accumulations and debris.
 - a. Clean cavity by use of hard rubber, wood or metal channel strips having soft material on sides contacting wythes.
 - b. Lift strips with wires before placing next courses of horizontal joint reinforcement or individual ties.
 2. For each lift lay two courses of concrete masonry units, followed by six courses of brick facing.

3.07 CONCRETE MASONRY UNITS

- A. Kind and Users:
1. Provide special concrete masonry shapes as required,
- B. Laying:
1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length, except where stack bond is required.
 2. Do not wet concrete masonry units before laying.
 3. Bond external corners of partitions by overlapping alternate courses.
 4. Lay first course in a full mortar bed.
 5. Set anchorage items as work progress.
 6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
 7. Provide a 6 mm (1/4 inch) open joint for caulking between existing construction.
 8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
 9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar. Unobstructed core openings not less than 50 mm (2 inches) by 75 mm (3 inches).

10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Install deformed reinforcing bars of sizes shown.
12. Steel reinforcement, at time of placement, free of loose flaky rust, mud, oil, or other coatings that will destroy or reduce bond.
13. Steel reinforcement in place before grouting.
14. Minimum clear distance between parallel bars: One bar diameter.
15. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
16. Support vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters.
17. Reinforcement shall be fully encased by grout or concrete.
18. Splice reinforcement or attach reinforcement to dowels by placing in contact and secured or by placing the reinforcement within 1/5 of the required bar splice length.
19. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
20. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.
21. Cavity and joint horizontal reinforcement may be placed as the masonry work progresses.

3.08 GROUTING

- A. Preparation:
1. Clean grout space of mortar droppings before placing grout.
 2. Close cleanouts.
 3. Install vertical solid masonry dams across grout space for full height of wall at intervals of not more than 9000 mm (30 feet). Do not bond dam units into wythes as masonry headers.
 4. Verify reinforcing bars are in cells of units or between wythes as shown.
- B. Placing:
1. Place grout by hand bucket, concrete hopper, or grout pump.
 2. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
 3. Do not slush with mortar or use mortar with grout.
 4. Interruptions:
 - a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.
 - b. Grout from dam to dam on high lift method.
 - c. A longitudinal run of masonry may be stopped off only by raking back one-half a masonry unit length in each course and stopping grout 100 mm (4 inches) back of rake on low lift method.
- C. Puddling Method:
1. Double wythe masonry constructed grouted in lifts not to exceed 300 mm (12 inches) or less than 50 mm (2 inches) wide.
 2. Consolidate by puddling with a grout stick during and immediately after placing.
 3. Grout the cores of concrete masonry units containing the reinforcing bars solid as the masonry work progresses.
- D. Low Lift Method:
1. Construct masonry to a height of 1.5 m (5 ft) maximum before grouting.
 2. Grout in one continuous operation and consolidate grout by mechanical vibration

and reconsolidate after initial water loss and settlement has occurred.

- E. High Lift Method:
 - 1. Do not pour grout until masonry wall has properly cured a minimum of 4 hours.
 - 2. Place grout in lifts not exceeding 1.5 m (5 ft).
 - 3. Exception: Where the following conditions are met, place grout in lifts not exceeding 3.86 m (12.67 ft).
 - a. The masonry has cured for at least 4 hours.
 - b. The grout slump is maintained between 254 and 279 mm (10 and 11 in).
 - c. No intermediate reinforced bond beams are placed between the top and the bottom of the pour height.
 - 4. When vibrating succeeding lifts, extend vibrator 300 to 450 mm (12 to 18 inches) into the preceding lift to close any shrinkage cracks or separation from the masonry units.

3.09 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.
- C. Splice reinforcement bars where shown; do not splice at other places unless accepted by the Resident Engineer. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.
- E. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- F. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.
- H. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

3.10 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

- A. Do not wet concrete masonry units (CMU).
- B. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not

less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 10 mm (3/8 inch) joints.

- C. Where solid CMU units are shown, lay with full mortar head and bed joints.
- D. Walls:
1. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jamps, sash, control joints, lintels, bond beams and other special conditions.
 2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
 3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.
- E. Columns, Piers and Pilasters:
1. Use CMU units of the size, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
 2. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.
- F. Grouting:
1. Use "Fine Grout" per ASTM C476 for filling spaces less than 100 mm (4 inches) in one or both horizontal directions.
 2. Use "Coarse Grout" per ASTM C476 for filling 100 mm (4 inch) spaces or larger in both horizontal directions.
 3. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow.
- G. Low-Lift Grouting:
1. Provide minimum clear dimension of 50 mm (2 inches) and clear area of 5160 mm² (8 square inches) in vertical cores to be grouted.
 2. Place vertical reinforcement prior to grouting of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 3 m (10 feet).
 3. Lay CMU to maximum pour height. Do not exceed 1.5 m (5 foot) height, or if bond beam occurs below 1.5 m (5 foot) height, stop pour 38 mm (1-1/2 in) below top of bond beam.
 4. Pour grout using chute container with spout or pump hose. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 38 mm (1-1/2 inches) below top course of pour.
 5. Bond Beams: Stop grout in vertical cells 38 mm (1-1/2 inches) below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

- H. High-Lift Grouting:
1. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 75 mm (3 inches) and 6450 mm² (10 square inches), respectively.
 2. Provide cleanout holes in first course at all vertical cells which are to be filled with grout.
 3. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
 4. Construct masonry to full height of maximum grout pour specified, prior to placing grout.
 5. Limit grout lifts to a maximum height of 1.5 m (5 feet) and grout pour to a maximum height of 7.3 m (24 feet), for single wythe hollow concrete masonry walls, unless otherwise indicated.
 6. Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 3 m (10 feet).
 7. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosed before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.
 8. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.
 9. Place horizontal beam reinforcement as the masonry units are laid.
 10. Embed lateral tie reinforcement in mortar joints where indicated. Place as masonry units are laid, at vertical spacing shown.
 11. Where lateral ties are shown in contact with vertical reinforcement bars, embed additional lateral tie reinforcement in mortar joints. Place as shown, or if not shown, provide as required to prevent grout blowout or rupture of CMU face shells, but provide not less than 4.1 mm diameter (8 gage) wire ties spaced 400 mm (16 inches) o.c. for members with 500 mm (20 inches) or less side dimensions, and 200 mm (8 inches) o.c. for members with side dimensions exceeding 500 mm (20 inches).
 12. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
 13. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
 14. Place grout by pumping into grout spaces unless alternate methods are acceptable to the Resident Engineer.
 15. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 1.5 m (5 feet). Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Mechanically consolidate each grout lift during pouring operation.
 16. Place grout in lintels or beams over openings in one continuous pour.
 17. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 25 mm (1 inch) of vertically reinforced cavities, during

- construction of masonry.
18. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 38 mm (1-1/2 inches) of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

3.11 CLEANING AND REPAIR

- A. General:
1. Clean exposed masonry surfaces on completion.
 2. Protect adjoining construction materials and landscaping during cleaning operations.
 3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
 4. Remove mortar droppings and other foreign substances from wall surfaces.
- B. Brickwork:
1. First wet surfaces with clean water, then wash down with a solution of soapless detergent. Do not use muriatic acid.
 2. Brush with stiff fiber brushes while washing, and immediately thereafter hose down with clean water.
 3. Free clean surfaces of traces of detergent, foreign streaks, or stains of any nature.
- C. Concrete Masonry Units:
1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
 2. Allow mud to dry before brushing.

--- E N D ---

SECTION 04 72 10
STONE VENEER WALL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies stone veneer planter using natural stone.

1.2 RELATED WORK

- A. Stone specified: Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Section 32 13 20, SITE CONCRETE
- C. Concrete Reinforcing Steel Institute (CRSI): "Manual of Standard Practice" and "Recommended Practice for Placing Reinforcing Bars".
- D. California Code of Regulations, Title 24, 2007 Edition, also known as California Building Code (CBC).
- E. Sustainable design requirements and procedures including submittal requirements: Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- F. Procedures and requirements for managing and disposing construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

1.3 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site with Resident Engineer.
- B. Stone samples for comparison of quality and color are available from the Landscape Architect or Contracting Officer. Contractor shall request access to these samples for review, prior to submitting samples for approval.
- C. Preconstruction Soil Testing: Engage a qualified independent testing agency to test soil reinforcement and backfill materials for compliance with design criteria.
- D. Installer Qualifications: Firm specializing in design and installation of stone walls and :
 - 1. With not less than 2 years documented experience.
 - 2. With a minimum of five previously constructed successful projects, similar in size and magnitude, using specified wall system; Provide contact names and numbers.
 - 3. Site supervisor with verifiable qualified experience suitable for this project.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

- B. Samples:
 - 1. Stone, samples 4 by 12 by 12 inches, each color and finish.
 - 2. Stone cap, end condition and full size, 1 color and finish. Finish on all 4 exposed faces as shown on Drawings.
- C. Shop Drawings:
 - 1. Stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
- D. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.
- E. Mockups: Build 8' long sample planter wall mockup including veneer over prepared, tested and approved concrete wall core to verify selections made under sample submittals and to demonstrate functional and aesthetic effects and set quality standards for materials and execution. Mockup should include color range, texture, bond pattern, and joints. Mockup shall include the corner end condition and cap throughout. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Do not continue masonry work until mock-up has been approved by Resident Engineer. Approved mock up shall be the standard of workmanship for the Project.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store cement, sand, Lime and stone under waterproof covers on planking clear of ground.
- B. Protect Stone from handling, dirt, stain, and water damage.

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21. Provide manufacturer's five year specialty warranty.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. Cast Stone Institute Technical Manual and Cast Stone Institute standard specifications.
- C. American Society for Testing and Materials (ASTM):
 - 1. A167-99 (2004) Stainless and Heat Resisting Chromium- Nickel Steel Plate, Sheet, and Strip
 - 2. A185-07 Steel, Welded Wire Fabric, Plain for Concrete
 - 3. A615/A615M-08 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 4. C33-07 Concrete Aggregates
 - 5. C150-07 Portland Cement
 - 6. C503-08 Marble Dimension Stone (Exterior)

- | | | |
|-----|---------|--|
| 7. | C568-08 | Limestone Dimension Stone |
| 8. | C615-03 | Granite Dimension Stone |
| 9. | C616-08 | Quartz-Based Dimension Stone |
| 10. | C979-05 | Pigments for Integrally Colored Concrete |

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT: ASTM C150, TYPE I.

2.2 SAND: ASTM C144; NATURAL SAND CONTAINING NOT MORE THAN 2% OF SILT AND CLAY BY WEIGHT WITH SPECIFIC GRAVITY NOT LESS THAN 2.65.

2.3 LIME: ASTM C5, SLAKE; SCREEN THROUGH 16 MESH, THEN STORE AND PROTECT FOR 10 DAYS.

2.4 PLANTER WALL SOLID STONE UNITS

- A. Natural stone quarried and sawn (except for face) into rectangular shapes and sizes for the planter wall as shown on Drawings.
1. Stone Type: Limestone
 2. Color:
 - a. "Chocolate" or approved equal in medium brown tones. Wall should consist of 2/3 this color.
 - b. "Caramel" or approved equal in light brown or khaki tones. Wall should consist of 1/3 this color.
 3. Stone native location: Lueders, Texas
 4. Texture: Split face on all exposed sides. Contractor shall cut, fabricate, and hand-work the stone in any combination of the 3, as necessary to produce the veneer and cap pieces as specified and as shown on the Drawings. Exceptions to the split face finish on all exposed sides are not acceptable.
 5. Saw cut on all non-exposed sides.
 6. Face Shape: rectangular with 90 degree corners and parallel sides
 7. Individual Stone Height: Varies shown on Drawings.
 8. Individual Stone Length (face Width): Varies as shown on Drawings.
 9. Width (Depth from Face) As Shown on Drawings.
 10. Warp bow or twist of stone shall not exceed length/360 or 1/8 inch, whichever is greater.
 11. Moisture Absorption: 6 percent, maximum
 12. Compressive Strength, Dry: 9,000 psi minimum.
 13. Dimensional Tolerances: Plus/minus 1/8 inch from specified dimensions.
 14. Appearance: Natural quarried face without machine marks or scrapes.
 15. Sawn as indicated within these specs shall be means and methods by the Contractor. The Contractor shall proceed in a manner that produces the stone units required as

specified herein and as shown on the Drawings. Any Stone that does not meet dimensional or finish Specification will be rejected at the Contractor's expense.

- B. Concrete Wall Core and Foundation: Reinforced concrete with compressive strength of 3,000 psi minimum.
- C. Drainage backfill: Class 2 permeable backfill per Caltrans with Subsurface Drain system as described herein.

2.5 GROUT: CONSIST OF 1 PART PORTLAND CEMENT AND 3 PARTS SAND. ADD UP TO 10% LIME. WHEN THE GROUT CORE IS 2" OR MORE WIDE, ADD 2 PARTS OF PEA GRAVEL TO THE ABOVE GROUT MIX. ADD WATER TO GROUT TO CAUSE IT TO FLOW WITHOUT SEGREGATION INTO ALL VOIDS INTENDED TO BE FILLED, AND TO PRODUCE A 28-DAY STRENGTH OF 2000 PSI. PLASTER SAND MAY BE ADDED TO PREVENT SEGREGATION, PROVIDED STRENGTH IS MAINTAINED. COLOR: MEDIUM TO LIGHT GRAY COLOR ADDED TO MORTAR. SUBMIT COLOR SAMPLES FOR ACCEPTANCE BY RESIDENT ENGINEER.

2.6 REINFORCING MATERIALS

- A. New, free of rust, Billet steel bars: Current ASTM designation A615.
- B. Bar Reinforcement: ASTM A615.
 - 1. #3 and smaller: Grade 40.
 - 2. #4 and larger: Grade 60.
 - 3. Tie wire: #6 minimum, black and annealed.
- C. Bar Reinforcement recycled content shall be a minimum of 75% recycled post consumer steel.
- D. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304.
- E. Stone anchors shall be as required to meet joint spacing indicated on Drawings.

2.7 ANCILLARY MATERIALS

- A. Dampproofing: Per CALTRANS Standard Specifications, Section 54.
- B. Subsurface Drain behind Retaining-Type Walls: All walls that retain 30 inches of soil or more shall include a subsurface drainage system to relieve water pressure in accordance with Section 68 of the CALTRANS Standard Specifications and as shown. If no subsurface drain is shown, provide corrugated polyethylene plastic tubing per 68-1.02K surrounded with an envelope of Class 2 permeable material per 68-1.025 and wrapped with filter fabric per 68-1.028. Connect drains to storm drain system as accepted by Resident Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide testing and subgrade preparation complete.

- B. Provide subgrade preparation and the base material installation complete, including clearing, grading, excavation, filling and dewatering. Take every precaution to obtain a subgrade of uniform bearing power compacted to a minimum of 95% relative compaction as determined by the ASTM D1557 laboratory test procedure and in Sections 19 and 20 of the Caltrans Standard Specifications.
- C. Do any necessary finish grading and compaction in addition to that performed in accordance with earthwork to bring subgrades after final compaction to required grades and sections as indicated. Place no material on muddy subgrade. Remove un-compactable material and replace with clean fill and compact as required.
- D. Excavate to lines and grades shown on Drawings. Do not disturb embankment or foundation beyond lines. Minimize over-excavation.
- E. After excavation and prior to placement of leveling materials, Contractor's Geotechnical engineer shall examine bearing soil surface to verify strength meets or exceeds design requirement and assumptions and issue report to Resident Engineer for acceptance. Replace any unsuitable bearing soil as directed by Geotechnical Engineer.

3.2 REINFORCEMENT

- A. Concrete wall and footing shall be steel reinforced

3.3 INSTALLATION

- A. Install in accordance with Drawings and applicable codes and regulations.
 - 1. Erection Tolerances:
 - a. Variation for face plane of a solid stone unit (split faced surface) may be 1/4" maximum.
 - b. Offset from true alignment between two connecting members (adjacent stone units) may be 3/8" maximum.
 - c. Joint spacing as indicated on Drawings. Deviation from specified joint spacing shall be 1/8 inch maximum for horizontal joints, 1/4 inch maximum for vertical joints.
 - 2. Mortar joints as shown on Drawings. Recess mortar joints as shown on Drawings. Provide pitch on joints in top surface of wall to drain. Strike all joints to provide dense mortar.
 - 3. Place first course of units on concrete foundation; check alignment and level. Check for full contact with base and for stability.
 - 4. Place units side by side aligning face of wall using string line or offset from base line.
 - 5. Insert anchoring devices as required. Check for proper alignment and batter. Place succeeding courses.
- B. Setting Stones:
 - 1. Distribute stones as shown on drawings. Brush free of dust or other foreign matter and thoroughly wet before placing. Set in full mortar beds.
 - 2. Provide sufficient number of stones to install complete wall from lines and grades shown on the drawings and details.

3.4 DAMPPROOFING

- A. Mop apply one heavy coat of asphalt to a minus 2 inches below finished soil grade on soil side of retaining wall.

3.5 CLEANUP:

- A. Exercise care that no mortar or grout comes in contact with exposed face of work. Clean immediately.
- B. Use only stiff fiber brushed and wooden scrapers in keeping work clean as it progresses or in cleaning down at completion. Use no metal implements.

3.6 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with Contractor's Waste Management Plan and Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the Contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

--- END OF SECTION---

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
B. Painting: Section 09 91 00, PAINTING.

1.3 QUALITY ASSURANCE:

- A. Fabricator and erector shall maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Work shall be fabricated in an AISC certified Category Conventional Steel Structures fabrication plant.
B. Before authorizing the commencement of steel erection, the controlling contractor shall ensure that the steel erector is provided with the written notification required by 29 CFR 1926.752. Provide copy of this notification to the Resident Engineer.

1.4 TOLERANCES:

- A. Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by Section 7, Code of Standard Practice for Buildings and Bridges, and by Standard Mill Practice - General Information LRFD Manual, Second Edition, Page 1-183, except as follows:
1. Elevation tolerance for column splice points at time member is erected is 10 mm (3/8 inch).
 2. Elevation tolerance for top surface of steel beams and girders at connections to columns at time floor is erected is 13 mm (1/2 inch).
 3. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

1.5 REGULATORY REQUIREMENTS:

- A. AISC: Specification for Structural Steel Buildings - LRFD Specification for Structural Steel Buildings.
B. AISC: Code of Standard Practice for Steel Buildings and Bridges.

1.6 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

- B. Shop and Erection Drawings: Complete
- C. Certificates:
 - 1. Structural steel.
 - 2. Steel for all connections.
 - 3. Welding materials.
 - 4. Shop coat primer paint.
- D. Test Reports:
 - 1. Welders' qualifying tests.
- E. Record Surveys.

1.7 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Institute of Steel Construction (AISC):
 - 1. Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design (Second Edition, 2005)
 - 2. Load and Resistance Factor Design Specification for Structural Steel Buildings (Second Edition, 1995)
 - 3. Code of Standard Practice for Steel Buildings and Bridges (2010).
- C. American National Standards Institute (ANSI):
 - B18.22.1-65(R2008).....Plain Washers
 - B18.22M-81(R2000).....Metric Plain Washers
- D. American Society for Testing and Materials (ASTM):
 - A6/A6M-09.....Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
 - A36/A36M-08.....Standard Specification for Carbon Structural Steel
 - A53/A53M-10.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - A123/A123M-09.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A242/A242M-04(R2009)....Standard Specification for High-Strength Low-Alloy Structural Steel
 - A283/A283M-03(R2007)....Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 - A307-10.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

- A325-10.....Standard Specification for Structural Bolts,
Steel, Heat Treated, 120/105 ksi Minimum Tensile
Strength
- A490-10.....Standard Specification for Heat-Treated Steel
Structural Bolts 150 ksi Minimum Tensile
Strength
- A500/A500M-10.....Standard Specification for Cold Formed Welded
and Seamless Carbon Steel Structural Tubing in
Rounds and Shapes
- A572/A572M-07.....Standard Specification for High-Strength
Low-Alloy Columbium-Vanadium Structural Steel
- A992/A992M-06.....Standard Specification for Structural Steel
Shapes
- E. American Welding Society (AWS):
D1.1/D1.1M-10.....Structural Welding Code-Steel
- F. Research Council on Structural Connections (RCSC) of The Engineering
Foundation:
Specification for Structural Joints Using ASTM A325 or A490 Bolts
- G. Military Specifications (Mil. Spec.):
MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing,
Repair
- H. Occupational Safety and Health Administration (OSHA):
29 CFR Part 1926-2001...Safety Standards for Steel Erection

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Structural Wide Flange Shapes: A992.
- B. Structural Channels: A36
- C. Structural Tubing: ASTM A500, Grade B.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts, Nuts and Washers:
 - 1. High-strength bolts, including nuts and washers: ASTM A325
 - 2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
 - 3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.
- F. Plates: A36 or A572 Gr 50 as noted on drawings
- G. Zinc Coating: ASTM A123.
- H. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

PART 3 - EXECUTION

3.1 CONNECTIONS (SHOP AND FIELD):

- A. Welding: Welding in accordance with AWS D1.1. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
- B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than proof load given in Specification for Structural Joints Using ASTM A325 or A490 Bolts. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators or the turn-of-the-nut method. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

3.2 FABRICATION:

- A. Fabrication in accordance with Chapter M, Specification for Steel Buildings - Load and Resistance Factor Design.

3.3 SHOP PAINTING:

- A. General: Shop paint steel with primer in accordance with Section 6, Code of Standard Practice for Steel Buildings and Bridges.
- B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.
- C. Do not apply paint to following:
 - 1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
 - 2. Surfaces which will be encased in concrete.
 - 3. Surfaces which will receive sprayed on fireproofing.
 - 4. Top flange of members which will have shear connector studs applied.
- D. Zinc Coated (Hot Dip Galvanized) per ASTM A123 (after fabrication):
Touch-up after erection: Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

3.4 ERECTION:

- A. General: Erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.
- B. Temporary Supports: Temporary support of structural steel frames during erection in accordance with Section 7, Code of Standard Practice for Steel Buildings and Bridges.

3.5 FIELD PAINTING:

- A. After erection, touch-up steel surfaces specified to be shop painted. After welding is completed, clean and prime areas not painted due to field welding.
- B. Finish painting of steel surfaces is specified in Section 09 91 00, PAINTING.

3.6 SURVEY:

- A. Prior to placement of concrete survey all anchor bolts. Correct bolt locations and elevations prior to concrete placement to meet the intended locations. Reports shall be prepared by Registered Land Surveyor or Registered Civil Engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS. Submit a certified report of survey to Resident Engineer for approval.
- B. Upon completion of finish bolting or welding on any part of the work, and prior to start of work by other trades that may be supported, attached, or applied to the structural steel work, submit a certified report of survey to Resident Engineer for approval. Reports shall be prepared by Registered Land Surveyor or Registered Civil Engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS. Report shall specify that location of structural steel is acceptable for plumbness, level and alignment within specified tolerances specified in the AISC Manual.

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**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
 - 1. Support for Wall Mounted Items.
 - 2. Railings.

1.02 RELATED WORK

- A. Structural steel: Section 05 12 00, STRUCTURAL FRAMING STEEL.
- B. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Prime and finish painting: Section 09 91 00, PAINTING.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
 - 1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
 - 2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
 - 3. Provide templates and rough-in measurements as required.

1.04 QUALITY ASSURANCE

- A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.
- B. Each product type shall be the same and be made by the same manufacturer.
- C. Assembled product to the greatest extent possible before delivery to the site.
- D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

1.05 APPLICABLE PUBLICATIONS

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

- B. American Society of Mechanical Engineers (ASME):
 - B18.6.1-81(R2008)..... Wood Screws
 - B18.2.2-10..... Square and Hex Nuts

- C. American Society for Testing and Materials (ASTM):
 - A36/A36M-12 Structural Steel
 - A53-A53M-12 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - A123/A123M-13 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A240/A240M-14 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications
 - A269-10..... Seamless and Welded Austenitic Stainless Steel Tubing for General Service
 - A307-14..... Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - A653/A653M-13 Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
 - C1107/C1107M-14..... Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - F436-11 Hardened Steel Washers
 - F468-12 Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
 - F593-13a Stainless Steel Bolts, Hex Cap Screws, and Studs
 - F1667-13 Driven Fasteners: Nails, Spikes and Staples

- D. American Welding Society (AWS):
 - D1.1/D1.1M-11 Structural Welding Code Steel
 - D1.3/D1.3M-08 Structural Welding Code Sheet Steel

- E. National Association of Architectural Metal Manufacturers (NAAMM)
 - AMP 500-06 Metal Finishes Manual
 - AMP 521-01 Pipe Railing Manual

- F. Structural Steel Painting Council (SSPC)/Society of Protective Coatings:
 - SP 1-04 No. 1, Solvent Cleaning
 - SP 2-04 No. 2, Hand Tool Cleaning
 - SP 3-04 No. 3, Power Tool Cleaning

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

- A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.

- B. Railings and Handrails: 900 N (200 pounds) in any direction at any point.

2.02 MATERIALS

- A. Structural Steel: ASTM A36.

- B. Stainless Steel: ASTM A167, Type 302 or 304.

- C. Steel Plate to be Bent or Cold Formed: ASTM A283, Grade C.

- D. Steel Sheet: ASTM A570; or cold-rolled ASTM A611, Class 1; of grade required for design loading.
- E. Galvanized Sheet: ASTM A446, of grade required for design loading.
- F. Primer Paint: As specified in Section 09 91 00, PAINTING.
- G. Stainless Steel Tubing: ASTM A269, type 302 or 304.
- H. Grout: ASTM C1107, pourable type.

2.03 HARDWARE

- A. Rough Hardware:
 - 1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
 - 2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.
- B. Fasteners:
 - 1. Bolts with Nuts:
 - a. ASME B18.2.2.
 - b. ASTM A307 for 415 MPa (60,000 psi) tensile strength bolts.
 - c. ASTM F468 for nonferrous bolts.
 - d. ASTM F593 for stainless steel.
 - 2. Screws: ASME B18.6.1.
 - 3. Washers: ASTM F436, type to suit material and anchorage.
 - 4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

2.04 FABRICATION GENERAL

- A. Material:
 - 1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
 - 2. Use material free of defects which could affect the appearance or service ability of the finished product.
- B. Size:
 - 1. Size and thickness of members as shown.
 - 2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same component on similar standard commercial items or in accordance with established shop methods.
- C. Connections:
 - 1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
 - 2. Field riveting will not be approved.
 - 3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
 - 4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
 - 5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.

6. Use Rivets and bolts of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
 7. Use stainless steel connectors for removable members machine screws or bolts.
- D. Fasteners and Anchors:
1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.
 2. Where fasteners and anchors are not shown, design the type, size, location and spacing to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and suit the sequence of installation.
 3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
 4. Fasteners for securing metal fabrication to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.
- E. Workmanship:
1. General:
 - a. Fabricate items to design shown.
 - b. Furnish members in longest lengths commercially available within the limits shown and specified.
 - c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
 - d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
 - e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
 - f. Prepare members for the installation and fitting of hardware.
 - g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
 - h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.
 2. Welding:
 - a. Weld in accordance with AWS.
 - b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.
 - c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
 - d. Finish welded joints to match finish of adjacent surface.
 3. Joining:
 - a. Miter or butt members at corners.
 - b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
 4. Anchors:
 - a. Where metal fabrications are shown to be preset in concrete, weld 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 150 mm (6 inches) long with 25 mm (one inch) hooked end, to back of member at 600 mm (2 feet) on center, unless otherwise shown.
 - b. Where metal fabrications are shown to be built into masonry use 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 250 mm (10 inches) long with 50 mm (2 inch) hooked end, welded to back of member at 600 mm (2 feet) on center, unless otherwise shown.
 5. Cutting and Fitting:

- a. Accurately cut, machine and fit joints, corners, copes, and miters.
 - b. Fit removable members to be easily removed.
 - c. Design and construct field connections in the most practical place for appearance and ease of installation.
 - d. Fit pieces together as required.
 - e. Fabricate connections for ease of assembly and disassembly without use of special tools.
 - f. Joints firm when assembled.
 - g. Conceal joining, fitting and welding on exposed work as far as practical.
 - h. Do not show rivets and screws prominently on the exposed face.
 - i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.
- F. Finish:
1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
 2. Steel and Iron: NAAMM AMP 504.
 - a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
 - b. Surfaces exposed in the finished work:
 - i. Finish smooth rough surfaces and remove projections.
 - ii. Fill holes, dents and similar voids and depressions with epoxy type patching compound.
 - c. Shop Prime Painting:
 - i. Surfaces of Ferrous metal:
 - (a) Items not specified to have other coatings.
 - (b) Galvanized surfaces specified to have prime paint.
 - (c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
 - (d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
 - (e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.
 - ii. Non ferrous metals: Comply with MAAMM-500 series.
 3. Stainless Steel: NAAMM AMP-504 Finish No. 4.
- G. Protection:
1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
 2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

2.05 SUPPORTS

- A. General:
1. Fabricate ASTM A36 structural steel shapes as shown.
 2. Use clip angles or make provisions for welding hangers and braces to overhead construction.
 3. Field connections may be welded or bolted.
- B. For Wall Mounted Items:
1. For items supported by metal stud partitions.
 2. Steel strip or studs minimum of 16 gauge (0.0625 inch) thick.

3. Steel stud channels minimum of 150 mm (6 inches) wide, length extending one stud space beyond end of item supported. Flange cut and flatted for anchorage to stud.
4. Steel strip minimum of 150 mm (6 inches) wide, length extending one stud space beyond end of item supported.

2.06 RAILINGS

- A. In addition to the dead load design railing assembly to support live load specified.
- B. Fabrication General:
 1. Provide continuous welded joints, dressed smooth and flush.
 2. Standard flush fittings, designed to be welded, may be used.
 3. Exposed threads will not be approved.
 4. Form handrail brackets to size and design shown.
- C. Handrails:
 1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts are shown.
 2. Make provisions for attaching handrail brackets to wall, and handrail as shown.
- D. Stainless Steel Railings:
 1. Fabricate from 38 mm (1-1/2 inches) outside diameter stainless steel tubing, ASTM A269, having a wall thickness of 1.6 mm (0.065 inch).
 2. Join sections by an internal connector to form hairline joints where field assembled.
 3. Fabricate with continuous welded connections.
 4. Fabricate brackets of stainless steel to design shown.
 5. Fabricate stainless steel sleeves at least 150 mm (6 inches) deep having internal dimensions at least 13 mm (1/2 inch) greater than external dimensions of post.

2.07 MISCELLANEOUS METAL

- A. Miscellaneous metal fabricated items are not necessary individually described. Provide all miscellaneous items not described as required to complete metal fabrication work.
- B. Provide all miscellaneous steel angles, channels, plates and shapes, threaded rods, pipes, bolts, nuts, washers, spacers and fastenings shown or required to complete the work.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
- B. Items set into concrete or masonry.
 1. Provide temporary bracing for such items until concrete or masonry is set.
 2. Place in accordance with setting drawings and instructions.
 3. Build strap anchors, into masonry as work progresses.
- C. Field weld in accordance with AWS.
 1. Design and finish as specified for shop welding.

2. Use continuous weld unless specified otherwise.
- D. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.
- E. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.
- F. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.
- G. Secure escutcheon plate with set screw.

3.02 INSTALLATION OF SUPPORTS

- A. Anchorage to structure.
 1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.
 2. Secure supports to concrete inserts by bolting or continuous welding as shown.
 3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts, unless shown otherwise.
 4. Secure steel plate or hat channels to studs as detailed.
- B. Supports for Wall Mounted items:
 1. Locate center of support at anchorage point of supported item.
 2. Locate support at top and bottom of wall hung cabinets.
 3. Locate support at top of floor cabinets and shelving installed against walls.
 4. Locate supports where required for items shown.

3.03 RAILINGS

- A. Handrails:
 1. Anchor brackets for metal handrails as detailed.
 2. Install brackets within 300 mm (12 inches) of return of walls, and at evenly spaced intermediate points not exceeding 1200 mm (4 feet) on centers unless shown otherwise.

3.04 CLEAN AND ADJUSTING

- A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.
- B. Clean after installation exposed prefinished and plated items and items fabricated from aluminum, as recommended by the metal manufacture and protected from damage until completion of the project.

--- E N D ---

SECTION 05 58 13
FORMED METAL COLUMN COVERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section specifies formed aluminum column covers, including reveals, batten seams, closures, joint covers, stiffeners, gaskets, sealants, fasteners, and other miscellaneous accessories as required for a complete installation for column covers.

1.02 RELATED WORK

- A. Structural steel framing: Section 05 12 00, STRUCTURAL STEEL.
- B. Miscellaneous metal members: Section 05 50 00, METAL FABRICATIONS.
- C. Sheet metal flashing and trim: Section 07 60 00, FLASHING AND SHEET METAL.
- D. Joint sealants: Section 07 92 00, JOINT SEALANTS.
- E. Point Support Fitting Systems: Section 08 44 23, STRUCTURAL GLAZING SUPPORT SYSTEM.
- F. Finish Color: Section 09 06 00, SCHEDULE FOR FINISHES.
- G. Metal framing: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall have a minimum of five (5) years documented successful experience in the fabrication of formed metal column cover systems similar to that required for this Project.
- B. Single Source Responsibility: All formed metal column covers and related accessories shall be the products of a single manufacturer.
- C. Installer's Qualifications: Installer shall have successfully installed column cover systems similar to that specified herein on no less than five (5) projects of comparable type and size. Installer shall be approved by the column cover system manufacturer to perform the Work of this Section.
- D. Field measurements should be taken prior to the completion of shop fabrication whenever possible. However, coordinate fabrication schedule with construction progress as directed by the Contractor to avoid delay of work. Field fabrication may be allowed to ensure proper fit. However, field fabrication shall be kept to an absolute minimum with the majority of the fabrication being done under controlled shop conditions.
- E. Welding Standards: Comply with applicable provisions of AWS D1.2 and AWS D1.6.
- F. Pre-installation Meeting: Conduct pre-installation meeting at site attended by COR, installer, manufacturer's technical representative, and affected trade contractors.
 - 1. Coordinate canopy structure framing in relation to formed metal column covers.
 - 2. Coordinate installation of adjacent materials and systems, and other openings and penetrations of formed metal column covers.

1.04 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Product Data: Submit manufacturer's specifications, installation instructions, applicable technical bulletins, color selection charts, material safety data sheets and, general treatment, handling and protection recommendations for each component of the formed metal column cover system.
 - 1. Include maintenance data.
- C. Shop Drawings:
 - 1. Provide shop drawings prepared by manufacturer or manufacturer's authorized dealer. Include elevations and sections showing openings and penetrations and interface with adjacent work. Include details of each condition of installation and attachment. Provide details at a minimum scale 1-1/2-inch per foot of all required trim and extrusions needed for a complete installation.
 - a. Include data indicating compliance with performance requirements.
 - b. Indicate points of supporting structure that must coordinate with formed metal column cover installation.
 - c. Distinguish between factory assembled and field assembled work.
- D. Samples:
 - 1. For Initial Selection: For each product and finish specified, including exposed sealants and gaskets. Provide representative color charts of manufacturer's full range of colors.
 - 2. For Final Verification: Provide 12-inch (300 mm) section of column showing finishes, horizontal joinery, vertical joint return, column stiffener and anchoring details, with gaskets and sealants installed. Provide 12-inch (300 mm) long pieces of each trim.
- E. Manufacturer's Test Reports and Certificates:
 - 1. Submit manufacturer's product test reports indicating compliance of products with requirements, from a qualified independent testing agency.
 - 2. Qualification certificates for installer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Protect products during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage.
- B. Deliver, unload, store, and erect column covers and accessory items without misshaping products or exposing products to surface damage from weather or construction operations.
- C. Store in accordance with Manufacturer's written instructions.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referred to in text by basic designation only.
- B. Aluminum Association:
AA-C22-A41Anodized - Clear Coatings

- AA-C22-A42Anodized - Integral Color Coatings
- C. American Architectural Manufacturers Association (AAMA):
 - AAMA 620 Voluntary Specification High Performance Organic Coatings on Coil Coated Architectural Aluminum
 - AAMA 621 Voluntary Specification High Performance Organic Coatings on Coil Coated Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates
 - AAMA 2605 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
- D. American Society for Testing and Materials (ASTM):
 - A653-15 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
 - A666-15 Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar
 - B209-14 Aluminum and Aluminum Alloy Sheet and Plate
 - B221-14 Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
 - C645-14 Nonstructural Steel Framing Members
- E. American Welding Society, Inc. (AWS):
 - D1.2/D1.2M Structural Welding Code-Aluminum
 - D1.6 Structural Welding Code - Stainless
- F. National Association of Architectural Metal Manufacturers (NAAMM):
 - 500 Series (2006) Metal Finishes Manual.

1.07 WARRANTY

- A. Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace column covers that fail in materials and workmanship within one year from date of Substantial Completion.
 - 1. Finish Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace column covers that evidence deterioration of finish within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Aluminum Face Sheet: Coil-coated, ASTM B209, 3003-H14 alloy.
 - 1. Face Sheet Thickness: 0.080 inch (2.0 mm) thick.
 - 2. Surface: Smooth.
- B. Aluminum Extrusions: ASTM B221, 6063-T5 alloy.
- C. Accessories:
 - 1. Provide manufacturer's recommended fasteners, shims, sealants, and gaskets required for a complete installation.
 - 2. Formed Trim and Closure: Aluminum, minimum thickness 0.063 inch (1.59 mm). Include manufacturer provided extruded trim or closure for the following locations and as indicated on Drawings:
 - a. Base trim or closure.

- b. Top trim or closure.
 - c. Reveal trim or closure.
 - 3. Stiffeners: Manufacturer's standard stiffeners and joint backing as required for installation.
- D. Fasteners: Provide self-tapping screws, bolts, nuts, self-locking rivets and bolts, and other suitable fasteners as required for installation.
 - 1. Concealed Fasteners: Corrosion-resistant, as recommended by column cover manufacturer for application.
- E. Sealant:
 - 1. Internal Sealants: As recommended by column cover manufacturer for application.
 - 2. Field Applied: As specified in Section 07 90 00, JOINT SEALANTS.

2.02 FORMED METAL COLUMN COVERS

- A. Reveal and Batten Seam Type Column Covers: Form column covers from metal substrate indicated, with vertical edges formed with return leg stiffener configured for fastening. Form vertical and horizontal joints as specified, in locations indicated on drawings.
 - 1. Column Cover Shape: Rectangular
 - 2. Substrate: Aluminum sheet.
 - 3. Horizontal Joints: 5/8-inch wide by 7/8-inch deep reveal.
 - 4. Vertical Joints: 5/8-inch wide by 3/4-inch deep reveal.

2.03 FABRICATION

- A. Perform field measurements prior to the fabrication of column covers.
- B. Coordinate details with details of adjacent work to assure watertightness, proper attachments, sealed joints, tight flashings and clean junctions.
- C. Column cover panel lines, breaks, and angles shall be sharp and true, and surfaces shall be free from warp or buckle.
- D. Column cover panel surfaces shall be free of scratches or marks caused during fabrication.
- E. Fabricate column covers and accessories at factory using manufacturer's standard procedures and processes to minimize field splicing and assembly. Form metal to indicated profiles to minimize joints. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise damaging the work. Provide extruded stiffeners as required to meet performance criteria specified herein.

2.04 FINISHES

- A. Comply with NAAMM's Metal Finishes Manual for architectural metal products recommendations for applying and designating finishes.
 - 1. Protect finishes by applying strippable temporary protective covering.
- B. Aluminum Sheet Coil-Coated Finish:
 - 1. Fluoropolymer Three-Coat System: 0.8 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, and a 0.8 mil 70 percent PVDF fluoropolymer clear coat, AAMA 621.

- C. Unexposed Finish: Manufacturer's standard primer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine column cover substrate and supports with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of column covers:
 - 1. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of column covers.
 - 2. Inspect framing that will support column covers to determine if support components are installed as indicated on approved shop drawings and are within tolerances acceptable to column cover manufacturer.
 - 3. Verify that penetrations and adjacent work match layout on shop drawings.
- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with column cover installation.
- C. If unsatisfactory conditions exist, do not proceed with installation until such conditions have been corrected.

3.02 PREPARATION

- A. Coordinate column cover work with the work of other trades and provide items to be placed during the installation of other work at the proper time to avoid delays in the work. Place such items, including inserts and anchor, accurately in relation to the final location of column cover components.
- B. Provide templates for inserts and other devices to the work of other trades, in sufficient time to be built into adjoining construction.
- C. Perform cutting, fitting, and other related work in connection with erection of column cover panel work.

3.03 INSTALLATION

- A. Install column covers in accordance with manufacturer's written instructions and recommendations, and reviewed shop drawings.
- B. Do not erect units which are observed to be warped, bowed, dented, deformed, abraded, broken members, or otherwise damaged or defaced to such extent as to impair strength or appearance. Remove and replace members damaged in the process of erection, as directed.
- C. Accurately place and line up each unit of work with adjoining parts. Install work with all joints level, plumb, and true within limits as set by the flatness of panels. Attach panels to structural supports by means of concealed anchorage system. No through penetrations or fasteners will be permitted.
- D. Do not cut, trim, weld, or braze component parts during erection, in a manner which would damage finish, decrease strength, or result in a visual imperfection or a failure in performance of wall panels. Return component parts which require alternation to shop for refabrication, if possible, or for replacement by new parts.

- E. Anchor components securely in place in the manner indicated. Shim and allow for movement resulting from changes in thermal conditions. Provide separators and isolators to prevent corrosion, electrolytic deterioration, and freeze-up of moving joints.
- F. Install work plumb, level and true, with components securely attached without audible vibration.
- G. Metal Separation: Apply a coat of bituminous paint, or other acceptable isolator (i.e., factory paint, zinc coating, plastic shims) concealed on one or both surfaces wherever dissimilar metals would otherwise be in contact. Use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.
- H. Attach column covers securely to supports using recommended clips, screws, fasteners, bolts and anchors, sealants, and adhesives indicated on approved shop drawings and as required to comply with performance requirements:
 - 1. Install column covers using concealed fasteners.
 - 2. Form tight joints with exposed connections accurately fitted together. Provide uniform reveals and openings for sealants and joint fillers as indicated.
 - 3. Horizontal Joinery: Provide joint type specified.
 - 4. Vertical Joinery: Provide joint type specified.
 - 5. Galvanic Action: Where elements of column covers and accessories will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.

3.04 ADJUSTING, CLEANING AND PROTECTION

- A. Remove temporary protective films. Clean finished surfaces as recommended by column cover manufacturer. Maintain in a clean and protected condition during construction.
- B. Remove and replace column covers damaged beyond repair. Repair column cover panels with minor damage.
- C. Clean exposed surfaces of column covers that are not protected by temporary covering to remove fingerprints and soil during construction period.
- D. Protect work from damage to surface, profile, and shape during and after erection and until project is accepted by the Government.

--- END ---

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Section specifies wood blocking, furring, nailer and rough hardware.

1.02 RELATED WORK

- A. Milled woodwork: Section 06 20 00, FINISH CARPENTRY.
- B. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect lumber and other products from dampness both during and after delivery at site.
- B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.
- C. Stack plywood and other board products so as to prevent warping.
- D. Locate stacks on well drained areas, supported at least 150 mm (6 inches) above grade and cover with well ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.05 JOB CONDITIONS

- A. Environmental Requirements: Maintain uniform moisture content of lumber at specified moisture content before, during, and after installation.
- B. Sequencing: Coordinate details with other Work supporting, adjoining, or fastening to rough carpentry Work.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - B18.2.1A-12 Square and Hex Bolts and Screws
 - B18.2.2-87(R2005)..... Square and Hex Nuts
 - B18.6.1-81 (R97)..... Wood Screws

- B18.6.4-98(R2005)..... Thread Forming and Thread Cutting Tapping Screws
and Metallic Drive Screws
- C. American Plywood Association (APA):
E30-11 Engineered Wood Construction Guide
- D. American Society for Testing And Materials (ASTM):
A653/A653M-13 Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy
Coated (Galvannealed) by the Hot Dip Process
C954-11 Steel Drill Screws for the Application of Gypsum Board
or Metal Plaster Bases to Steel Studs from 0.033 inch
(2.24 mm) to 0.112-inch (2.84 mm) in thickness
C1002-14 Steel Self-Piercing Tapping Screws for the Application of
Gypsum Panel Products or Metal Plaster Bases to Wood
Studs or Metal Studs
D143-14 Small Clear Specimens of Timber, Method of Testing
F844-07a Washers, Steel, Plan (Flat) Unhardened for General Use
F1667-13 Nails, Spikes, and Staples
- E. Federal Specifications (Fed. Spec.):
MM-L-736C Lumber; Hardwood
- F. Commercial Item Description (CID):
A-A-55615 Shield, Expansion (Wood Screw and Lag Bolt Self
Threading Anchors)
- G. Military Specification (Mil. Spec.):
MIL-L-19140E Lumber and Plywood, Fire-Retardant Treated
- H. U.S. Department of Commerce Product Standard (PS)
PS 1-09 Construction and Industrial Plywood
PS 20-10 American Softwood Lumber Standard

PART 2 – PRODUCTS

2.01 LUMBER

- A. Unless otherwise specified, each piece of lumber bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
1. Identifying marks in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
 2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.
- B. Lumber Other Than Structural:
1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
 2. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and, members 150 mm (6 inches) and wider, Number 2 Grade.

- C. Sizes:
 - 1. Conforming to Prod. Std., PS20.
 - 2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

- D. Moisture Content:
 - 1. At time of delivery and maintained at the site.
 - 2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
 - 3. Lumber over 50 mm (2 inches) thick: 25 percent or less.

- E. Fire Retardant Treatment:
 - 1. Mil Spec. MIL-L-19140 with piece of treated material bearing identification of testing agency and showing performance rating.
 - 2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.

- F. Preservative Treatment:
 - 1. Do not treat Heart Redwood and Western Red Cedar.
 - 2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including sills, furring, nailers, edge strips, blocking, crickets, cant, vent strips and other members used in connection with roofing and flashing materials.
 - 3. Treat other members specified as preservative treated (PT).
 - 4. Preservative treat by the pressure method complying with ASTM D1760, except any process involving the use of Chromated Copper arsenate (CCA) for pressure treating wood is not permitted.

2.02 PLYWOOD

- A. Comply with Prod. Std., PS 1.

- B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

- C. APA rated Exposure 1 or Exterior; panel grade CD or better.

2.03 ROUGH HARDWARE AND ADHESIVES

- A. Anchor Bolts:
 - 1. ASME B18.2.1 and ANSI B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
 - 2. Extend at least 200 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

- B. Miscellaneous Bolts: Expansion Bolts: C1D, A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Use 13 mm (1/2 inch) bolt unless shown otherwise.

- C. Washers
 - 1. ASTM F844.
 - 2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.

- D. Screws:
 - 1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.
 - 2. Wood to Steel: ASTM C954, or ASTM C1002.

- E. Nails:
 - 1. Size and type best suited for purpose unless noted otherwise. Use aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
 - 2. ASTM F1667:
 - a. Common: Type I, Style 10.
 - b. Concrete: Type I, Style 11.
 - c. Barbed: Type I, Style 26.

PART 3 – EXECUTION

3.01 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

- A. Conform to applicable requirements of the following:
 - 1. APA for installation of plywood.

- B. Fasteners:
 - 1. Nails:
 - a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA Manual for House Framing where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.
 - b. Use eight penny or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.
 - c. Use 16 penny or larger nails for nailing through 50 mm (2 inch) thick lumber.
 - 2. Bolts:
 - a. Fit bolt heads and nuts bearing on wood with washers.
 - b. Countersink bolt heads flush with the surface of nailers.
 - c. Embed in concrete and solid masonry or use expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
 - d. Use toggle bolts to hollow masonry or sheet metal.
 - e. Use bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 600 mm (24 inch) intervals between end bolts. Use clips to beam flanges.
 - 3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.
 - a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
 - b. ASTM C 954 for steel over 0.84 mm (0.033 inch) thick.
 - 4. Power actuated drive pins may be used where practical to anchor to solid masonry, concrete, or steel.
 - 5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Use metal plugs, inserts or similar fastening.
 - 6. Screws to Join Wood:
 - a. Where shown or option to nails.
 - b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
 - c. Spaced same as nails.

- C. Cut notch, or bore in accordance with NFPA Manual for House-Framing for passage of ducts, wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.

- D. Blocking, Nailers, and Furring:
 - 1. Install furring, blocking, nailers, and grounds where shown.
 - 2. Use longest lengths practicable.
 - 3. Use fire retardant treated wood blocking where shown at openings and where shown or specified.
 - 4. Layers of Blocking:
 - a. Stagger end joints between upper and lower pieces.
 - b. Nail at ends and not over 600 mm (24 inches) between ends.
 - c. Stagger nails from side to side of wood member over 125 mm (5 inches) in width.

--- E N D ---

**SECTION 07 60 00
FLASHING AND SHEET METAL**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Formed sheet metal work for flashings, gutters, downspouts, drainage specialties and accessories are specified in this section.

1.02 RELATED WORK

- A. Joint Sealants: Section 07 92 00, JOINT SEALANTS.
- B. Color of factory coated exterior architectural metal items: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Paint materials and application: Section 09 91 00, PAINTING.

1.03 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
- B. Aluminum Association (AA):
 - AA-C22A41 Aluminum Chemically etched medium matte, with clear anodic coating, Class I Architectural, 0.7-mil thick
- C. American National Standards Institute/Single-Ply Roofing Institute (ANSI/SPRI):
 - ANSI/SPRI ES-1-09 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems
- D. American Architectural Manufacturers Association (AAMA):
 - AAMA 620 Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Aluminum
 - AAMA 621 Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates
- E. ASTM International (ASTM):
 - A167-99(2009) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - A653/A653M-13 Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated (Galvanized) by the Hot- Dip Process
 - B32-08..... Solder Metal
 - B209-10..... Aluminum and Aluminum-Alloy Sheet and Plate
 - D1187/D1187M-97(2011)e1 Asphalt Base Emulsions for Use as Protective Coatings for Metal
- F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - Architectural Sheet Metal Manual.

- G. National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-06 Metal Finishes Manual
- H. Federal Specification (Fed. Spec):
A-A-1925A..... Shield, Expansion; (Nail Anchors)
UU-B-790A..... Building Paper, Vegetable Fiber
- I. International Code Commission (ICC): International Building Code, Current Edition

1.04 QUALITY ASSURANCE

- A. Work shall conform to the standards in the latest edition of the "Architectural Sheet Metal Manual" published by the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- B. Contractor shall be responsible to furnish and install flashing and sheet metal Work that is permanently watertight, and that withstands wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and/ or fastener disengagement.

1.05 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Fully detailed, large-scale drawings showing joint locations, profiles, dimensions, methods of joining and forming sections, and attachments to adjoining Work for all specially fabricated sheet metal Work including, but not limited to, the following items:
 - 1. Flashings
 - 2. Gutter and Conductors
 - 3. Downspouts
- C. Certificates: Indicating compliance with specified finishing requirements, from applicator and contractor.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver flashing and sheet metal materials and fabrications to the Site undamaged, being careful to protect items during transportation and handling.
- B. Unload, store and install flashing and sheet metal materials and fabrications in a manner that prevents bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets protected from the weather. Do not store flashing and sheet metal materials in contact with other materials that might cause staining, denting, corrosion, or other surface damage.

1.07 COORDINATION

- A. Coordinate Work of this Section with interfacing and adjoining Work to ensure proper sequencing of each installation and to provide a watertight, secure and noncorrosive installation.

PART 2 – PRODUCTS

2.01 FLASHING AND SHEET METAL MATERIALS

- A. Aluminum Sheet: ASTM B209, alloy 3003-H14.
- B. Galvanized Sheet Steel: ASTM, A653.

2.02 FLASHING ACCESSORIES

- A. Solder: ASTM B32; flux type and alloy composition as required for use with metals to be soldered.
- B. Bituminous Paint: ASTM D1187, Type I.
- C. Fasteners:
 - 1. Use stainless steel for aluminum alloy and galvanized steel.
 - 2. Nails:
 - a. Minimum diameter for aluminum nails 3 mm (0.105 inch).
 - b. Minimum diameter for stainless steel nails: 2 mm (0.095 inch) and annular threaded.
 - c. Length to provide not less than 22 mm (7/8 inch) penetration into anchorage.
 - 3. Rivets: Not less than 3 mm (1/8 inch) diameter.
 - 4. Expansion Shields: Fed Spec A-A-1925A.
- D. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.
- E. Primer Coating: Zinc-dust/ zinc-oxide metal primer, and as recommended by the sheet metal manufacturer for the metal to which it will be applied.
- F. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and other similar accessories as required for a complete installation. Accessory materials shall be non-corrosive, shall match or be compatible with the materials being installed, and shall be of size and gauge as required for continued system performance.
- G. Gaskets: Type suitable for use in conjunction with sheet metal. Gaskets shall be non-staining, non-corrosive, non-shrinking, non-sagging, and ultra-violet (UV) and ozone resistant for exterior concealed applications.

2.03 SHEET METAL THICKNESS

- A. Except as otherwise shown or specified use thickness or weight of sheet metal as follows:
- B. Concealed Locations (Built into Construction):
 - 1. Galvanized steel: 0.5 mm (0.021 inch) minimum.
- C. Exposed Locations:
 - 1. Thickness of aluminum or galvanized steel is specified with each item.

2.04 FABRICATION, GENERAL

- A. Jointing:
 - 1. Joints shall conform to following requirements:

- a. Flat-lock joints shall finish not less than 19 mm (3/4 inch) wide.
 - b. Lap joints subject to stress shall finish not less than 25 mm (one inch) wide and shall be soldered and riveted.
 - c. Unsoldered lap joints shall finish not less than 100 mm (4 inches) wide.
2. Flat and lap joints shall be made in direction of flow.
 3. Soldering:
 - a. Treat in accordance with metal producers recommendations other sheet metal required to be soldered.
 - b. Completely remove acid and flux after soldering is completed.

2.05 FINISHES

- A. Use same finish on adjacent metal or components and exposed metal surfaces unless specified or shown otherwise.
- B. In accordance with NAAMM Metal Finishes Manual AMP 500, unless otherwise specified.
- C. Finish exposed metal surfaces as follows, unless specified otherwise:
 1. Aluminum:
 - a. Colored Finish: AA-C22A44 (electrolytically deposited metallic compound) medium matte, integrally colored coating, Class 1 Architectural, 18 mm (0.7 mils) thick. Dyes will not be accepted.
 2. Steel and Galvanized Steel:
 - a. Manufacturer's finish:
 - i. Baked on prime coat over a phosphate coating.

2.06 FLASHINGS

- A. Fabricate from aluminum sheet, unless specified otherwise.
- B. Profile and size as shown on Drawings.
- C. Provide stiffeners as required.
- D. Provide miter joints at all corners.

2.07 GUTTERS

- A. Fabricate gutters of galvanized steel, not less than 20 gauge thick.
- B. Fabricate gutters in sections not less than 2400 mm (8 feet) long, except at ends of runs where shorter lengths are required.
- C. Gutter Spacers:
 1. Fabricate of same material and thickness as gutter.
 2. Fabricate 25 mm (one inch) wide strap and fasten to gutters not over 900 mm (36 inches) on center.
 3. Turn back edge up 25 mm (one inch) and lap front edge over gutter bead.
 4. Rivet and solder to gutter.
- D. Outlet Tubes:
 1. Form outlet tubes to connect gutters to conductors of same metal and thickness as gutters extend into the conductor 75 mm (3 inch). Flange upper end of outlet tube 13 mm (1/2 inch).
 2. Lock and solder longitudinal seam.

3. Solder tube to gutter.
 4. Fabricate basket strainers of same material as gutters.
- E. Gutter Brackets:
1. Fabricate of same metal as gutter. Use the following:
 - a. 3 by 25 mm galvanized steel.
 2. Fabricate to gutter profile.
 3. Drill two 5 mm (3/16 inch) diameter holes in anchor leg for countersunk flat head screws.

2.08 CONDUCTORS (DOWNSPOUTS)

- A. Fabricate conductors of same metal and thickness as gutters in sections approximately 3000 mm (10 feet) long with 19 mm (3/4 inch) wide flat locked seams.
- B. Fabricate elbows by mitering, riveting, and soldering. Lap upper section to the inside of the lower piece.
- C. Fabricate conductor brackets or hangers of same material as conductor, 2 mm (1/16 inch) thick by 25 mm (one inch) minimum width. Form to support conductors 25 mm (one inch) from wall surface in accordance with Architectural Sheet Metal Manual Plate 34, Design C for rectangular shapes.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General:
 1. Install flashings and sheet metal items as shown in Sheet Metal and Air Conditioning Contractors National Association, Inc., publication, ARCHITECTURAL SHEET METAL MANUAL, except as otherwise shown or specified.
 2. Coordinate the installation of flashing and sheet metal Work specified herein with the Work of other Trades. Work of this Section which interfaces with a specified weatherproofing, waterproofing, and/ or rain drainage system shall be considered an integral component of such system, and shall likewise provide watertight performance.
 3. Apply Sealant as specified in Section 07 92 00, JOINT SEALANTS.
 4. Apply sheet metal and other flashing material to surfaces which are smooth, sound, clean, dry and free from defects that might affect the application.
 5. Remove projections which would puncture the materials and fill holes and depressions with material compatible with the substrate. Cover holes or cracks in wood wider than 6 mm (1/4 inch) with sheet metal compatible with the roofing and flashing material used.
 6. Confine direct nailing of sheet metal to strips 300 mm (12 inch) or less wide. Nail flashing along one edge only. Space nail not over 100 mm (4 inches) on center unless specified otherwise.
 7. Install bolts, rivets, and screws where indicated, specified, or required in accordance with the SMACNA Sheet Metal Manual. Space rivets at 75 mm (3 inch) on centers in two rows in a staggered position. Use neoprene washers under fastener heads when fastener head is exposed.
 8. Install flashings in conjunction with other trades so that flashings are inserted in other materials and joined together to provide a water tight installation.

9. Where required to prevent galvanic action between dissimilar metal isolate the contact areas of dissimilar metal with sheet lead, waterproof building paper, or a coat of bituminous paint.
10. Isolate aluminum in contact with dissimilar metals others than stainless steel or other metal compatible with aluminum by:
 - a. Paint dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
 - b. Paint dissimilar metal with a coat of bituminous paint.
 - c. Apply an approved caulking material between aluminum and dissimilar metal.
11. Form sheet metal on a bending brake. Perform shaping, trimming, and hand seaming in the shop as much as possible. All lines shall be straight and crisp except where the thickness of metal dictates a radius bend, and all exposed edges shall be hemmed 1/2-inch minimum, unless otherwise noted.
12. Lay out metal flashing to minimize transverse joints. Detail transverse joints in all flashing pieces to provide a watertight connection and to allow for expansion/contraction of the metal.
13. Provide shop-fabricated corner and transition pieces to limit field joinery other than transverse joints. Shop-fabricate inside coping corners, outside coping corners, and horizontal-to-vertical transitions with a minimum 12-inch stub in each linear direction.

3.02 FLASHINGS

- A. Secure flashings as shown.
- B. Joint ends will butt splice joints and back plate, sealed for watertight.

3.03 GUTTERS

- A. Install gutters with high points equidistant from downspouts. Slope at not less than 1:100 (1/8 inch per foot).
- B. Lap joints, except for expansion joints, at least 25 mm (one inch) in the direction of flow. Rivet and seal or solder lapped joints.
- C. Support gutters in brackets spaced not more than 600 mm (24 inch) on centers, brackets attached to facial or wood nailer by at least two screws or nails.
 1. Use stainless steel screws.
- D. Secure brackets to gutters in such a manner as to allow free movement of gutter due to expansion and contraction.
- E. Outlet Tubes: Set bracket strainers loosely into gutter outlet tubes.

3.04 CONDUCTORS (DOWNSPOUTS)

- A. Sleeve conductors to gutter outlet tubes and fasten joint and joints between sections.
- B. Set conductors plumb and clear of wall, and anchor to wall with two anchor straps, located near top and bottom of each section of conductor. Strap at top shall be fixed to downspout, intermediate straps and strap at bottom shall be slotted to allow not less than 13 mm (1/2 inch) movement for each 3000 mm (10 feet) of downspout.

- C. Install elbows, offsets and shoes where shown and required. Slope not less than 45 degrees.

3.05 CLEANING AND ADJUSTMENT

- A. Leave Work clean and free of stains, scraps, and debris. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Repair and replace any damaged Work.

--- E N D ---

**SECTION 07 92 00
JOINT SEALANTS**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section covers interior and exterior sealant and their application, wherever required for complete installation of building materials or systems.

1.02 RELATED WORK

- A. Sealing of Site Work Concrete Paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Glazing: Section 08 80 00, GLAZING.

1.03 QUALITY CONTROL

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 - 3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- D. Lab Tests: Submit samples of materials that will be in contact or affect joint sealants to joint sealant manufacturers for tests as follows:
 - 1. Adhesion Testing: Before installing elastomeric sealants, test their adhesion to protect joint substrates according to the method in ASTM C794 to determine if primer or other specific joint preparation techniques are required.
 - 2. Compatibility Testing: Before installing elastomeric sealants, determine compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Perform testing per ASTM C1248 on interior and exterior sealants to determine if sealants or primers will stain adjacent surfaces. No sealant work is to start until results of these tests have been submitted to the Contracting Officer Representative (COR) and the COR has given written approval to proceed with the work.
- E. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
 - 1. Primers
 - 2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not proceed with installation of joint sealants under following conditions:
 - a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).
 - b. When joint substrates are wet.
- B. Joint-Width Conditions:
 - 1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions:
 - 1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.06 DELIVERY, HANDLING, AND STORAGE

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures exceeding 32° C (90° F) or less than 5° C (40° F).

1.07 DEFINITIONS

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

1.08 WARRANTY

- A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be extended to two years.
- B. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.09 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C509-06(2011) Elastomeric Cellular Preformed Gasket and Sealing Material.
 - C612-14 Mineral Fiber Block and Board Thermal Insulation.
 - C717-14a Standard Terminology of Building Seals and Sealants.
 - C834-14 Latex Sealants.
 - C919-12 Use of Sealants in Acoustical Applications.
 - C920-14a Elastomeric Joint Sealants.
 - C1021-08(2014) Laboratories Engaged in Testing of Building Sealants.
 - C1193-13 Standard Guide for Use of Joint Sealants.
 - C1330-02(2013) Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - D1056-14 Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
 - E84-14 Surface Burning Characteristics of Building Materials.
- C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide

PART 2 - PRODUCTS

2.01 SEALANTS

- A. Exterior Sealants:
 - 1. S-1: Vertical surfaces, provide non-staining ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
 - 2. S-2: Horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T.
 - 3. Provide location(s) of exterior sealant as follows:
 - a. Metal to metal.
 - b. Masonry to masonry.
 - c. Masonry expansion and control joints.
- B. Floor Joint Sealant:
 - 1. S-3: ASTM C920, Type S or M, Grade P, Class 25, Use T.
 - 2. Provide location(s) of floor joint sealant as follows.
 - a. Control and expansion joints in walkways.

- C. Interior Sealants:
 - 1. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system are to comply with the following limits for VOC content when calculated according to 40 CFR 59, (EPA Method 24):
 - a. Architectural Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.//
 - 2. S-4: Vertical and Horizontal Surfaces: ASTM C920, Type S or M, Grade NS, Class 25, Use NT.
 - 3. Provide location(s) of interior sealant as follows:
 - a. Typical narrow joint 6 mm, (1/4 inch) or less at walls and adjacent components.

2.02 COLOR

- A. Sealants used with exposed masonry are to match color of mortar joints.
- B. Sealants used with unpainted concrete shall match color of adjacent concrete.
- C. Color of sealants for other locations shall be light gray or aluminum, unless otherwise indicated in construction documents.

2.03 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.04 FILLER

- A. Mineral fiber board: ASTM C612, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.05 PRIMER

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

2.06 CLEANERS-NON POUROUS SURFACES

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.02 PREPARATIONS

- A. Prepare joints in accordance with manufacturer's instructions and SWRI (The Professionals' Guide).
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
- C. Do not cut or damage joint edges.
- D. Apply non-staining masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
1. Apply primer prior to installation of back-up rod or bond breaker tape.
 2. Use brush or other approved means that will reach all parts of joints. Avoid application to or spillage onto adjacent substrate surfaces.

3.03 BACKING INSTALLATION

- A. Install backing material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install backing rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for backing rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.

3.04 SEALANT DEPTHS AND GEOMETRY

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.05 INSTALLATION

- A. General:
 1. Apply sealants only when ambient temperature is between 5° C and 38° C (40° and 100° F).
 2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
 3. Do not install sealant type listed by manufacture as not suitable for use in locations specified.
 4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
 5. Avoid dropping or smearing compound on adjacent surfaces.
 6. Fill joints solidly with compound and finish compound smooth.
 7. Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C1193 unless shown or specified otherwise in construction documents. Remove masking tape immediately after tooling of sealant and before sealant face starts to "skin" over. Remove any excess sealant from adjacent surfaces of joint, leaving the working in a clean finished condition.

8. Finish paving or floor joints flush unless joint is otherwise detailed.
 9. Apply compounds with nozzle size to fit joint width.
 10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
 11. Replace sealant which is damaged during construction process.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise. Take all necessary steps to prevent three-sided adhesion of sealants.
- C. Interior Sealants: Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
 2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
 3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
 4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
 5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.06 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for first 305 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.
- B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

3.07 CLEANING

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by manufacturer of the adjacent material or if not otherwise indicated by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

--- E N D ---

**SECTION 08 44 23
GLAZING SUPPORT SYSTEMS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section specifies glass guardrail and barrier point support fittings, point support fittings for glass canopy systems, glass attachments, metal fasteners, sealant and related accessories.

1.02 RELATED WORK

- A. Structural steel: Section 05 12 00, STRUCTURAL STEEL FRAMING.
- B. Miscellaneous metal members: Section 05 50 00, METAL FABRICATIONS.
- C. Sheet metal flashing and trim: Section 07 60 00, FLASHING AND SHEET METAL.
- D. Joint sealants: Section 07 92 00, JOINT SEALANTS.
- E. Glazing: Section 08 80 00, GLAZING.
- F. Finish Color: Section 09 06 00, SCHEDULE FOR FINISHES.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall have a minimum of five (5) years documented successful experience in the fabrication of glazing support systems similar to that required for this Project.
- B. Single Source Responsibility: All components of glazing support systems and related accessories shall be the products of a single manufacturer.
 - 1. Glazing support system manufacturer shall provide all fabrication and assembly of glazing support systems.
- C. Installer's Qualifications: Installer shall have successfully installed glazing support system similar to that specified herein on no less than three (3) projects of comparable type and size. Installer shall be approved by the glazing support system manufacturer to perform the Work of this Section.
- D. Field measurements should be taken prior to the completion of shop fabrication whenever possible. Field fabrication may be allowed to ensure proper fit. However, field fabrication shall be kept to an absolute minimum with the majority of the fabrication being done under controlled shop conditions.

1.04 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Product Data:
 - 1. Manufacturer's specifications, installation recommendations, and standard details, including fabrication, finishing, and other components of the Work. Manufacturer's storage and handling procedures.

- C. Shop Drawings: Plans, sections, elevations, and details with glazing support fittings identified by manufacturer's part numbers, dimensions, materials, finishes, connections, method of anchorage to structure and glass thickness and type.
- D. Samples:
 - 1. Sample of point support fitting of each type.
- E. Quality Assurance Compliance: Submit letters from manufacturer and installers testifying that they are in compliance with the requirements of the Contract Documents and specifically attesting to the sole source requirements and installer requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials properly protected against damage to finished surfaces during transit.
- B. Inspect materials upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.
- C. Store materials at building site under cover in dry location.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referred to in text by basic designation only.
- B. American Architectural Manufacturers Association (AAMA):
501-05 Methods of Test for Exterior Walls
- C. American Society for Testing and Materials (ASTM):
A666-15 Standard Specification for Annealed or Cold-Worked Austenitic
Stainless Steel Sheet, Strip, Plate and Flat Bar
A743-13ae1 Standard Specification for Castings, Iron Chromium, Iron
Chromium Nickel, Corrosion Resistant, for General Applications.
E330/E330M-14 Standard Test Method for Structural Performance of Exterior
Windows, Doors, Skylights and Curtain Walls by Uniform Static
Air Pressure Difference
F593-13a Standard Specifications for Stainless Steel Bolts, Hex Cap
Screws, and Studs
- D. American Welding Society, Inc. (AWS):
D1.2/D1.2M-03 Structural Welding Code-Aluminum
- E. Consumer Product Safety Commission (CPSC):
16 CFR 1201 Architectural Glazing Standards and Related Material
- F. National Association of Architectural Metal Manufacturers (NAAMM):
500 Series (2006) Metal Finishes Manual.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Design Requirements:

1. Fittings shall be designed to be integrated into the glazing system.
 2. The design of the fittings is the sole responsibility of glazing support system manufacturer. All fitting sizes must be in accordance with profiles and sizes shown on drawings. Size of fittings is critical to the design of the glass pane.
 3. Movement diaphragms of stainless steel and durable flexible discs must be incorporated in connections to accommodate oversize holes in spring plate members which allow for thermal movement and glass manufacturing tolerances.
 4. Spring plate members are designed to prevent high stress concentration at the hole positions and must cope with:
 - a. Negative and positive wind loading.
 - b. Seismic loads.
 - c. Thermal movement.
 - d. Construction tolerances.
 - e. Live load and dead load movements.
 5. The system shall provide for unitized pre-fixing of all items to glass prior to erection.
- B. Performance Requirements:
1. System shall meet or exceed all performance requirements specified.
 2. Glazing support system components shall have been tested in accordance with requirements below and shall meet performance requirements specified:
 3. Design Wind Load: Design glazing system, including glass, to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass based upon wind loads as calculated in accordance with ASCE 7- Minimum Design Loads for Buildings and Other Structures, based on a minimum Basic Wind Speed of 100 miles per hour and Exposure B.
 4. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with IBC and CBC code for Seismic Zone E. The glazing support system assembly as installed shall be capable of handling relative horizontal and vertical displacement due to a seismic drift.
 5. Uniform-Load Structural Calculations: There shall be no permanent deformation of glass and hardware when designed to withstand a minimum of Basic Wind Speed of 100 miles per hour and Exposure B.

2.02 MATERIALS

- A. Austenitic Stainless Steel castings: ASTM A743, 316 Alloy, Grade CF 8 or CF 8M.
- B. Fasteners: Stainless Steel bolts: ASTM F593; 316 Alloy.
- C. Gaskets: Fully vulcanized fiber, neoprene or procured silicone.

2.03 COMPONENTS

- A. Glazing: As specified in Section 08 80 00 GLAZING.
- B. Point Support Fittings:
 1. General:
 - a. Fittings are stainless steel 316 Alloy, in brushed finish.
 - b. Fittings to be heavy duty to accommodate glass thickness from 1/2 inch to 1-1/16 inch.
 2. Heavy Duty Spider Fittings for Glass Canopy:
 - a. Single Arm Fitting used to attach a single glass panel to a structural end beam.

- b. Double Arm Fitting used to attach two in-line glass panels to a structural center beam.
- c. Glass Attachment:
 - i. Rigid Head Combination Glass Attachment Fittings; Cap mount for glass 1 1/8-inch thick.
- 3. Heavy Duty Spider Fittings for Glass Guardrail and Glass Barrier:
 - a. Wall/Fin Mount: Double Arm Wall/Fin Fitting used to attach two in-line glass panels to a structural fin.
 - b. Glass Attachment:
 - i. Rigid Head Combination Glass Attachment Fittings, Cap mount for glass 3/4-inch thick.
 - ii. Swivel Head Combination Glass Attachment Fittings, fittings can tilt up to 6 degrees in any direction on its ball and socket joint, Cap mount for glass 3/4-inch thick.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces receiving the Work. Verify dimensions of in-place and subsequent construction. Follow the recommendations of the FGMA as to inspection procedures. Do not begin work until unsatisfactory conditions have been corrected. Installation of work shall constitute acceptance of the related construction.
- B. Verify dimensions, tolerances, and method of attachment with other work.

3.02 PREPARATION

- A. Prime and paint steel supporting work before installation. Apply a protective coating of type in accordance with manufacturer's recommendations to separate aluminum from dissimilar metals.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved shop drawings for installation of glazing support system, glazing, and other components.
- B. Point support fittings to be mounted to structural beam, plate or angle as shown on drawings.
- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- F. Tolerances:
 - 1. Maximum Variation From True Position: +/- 1/8 inch maximum in 12 ft – 0 inch runs, non-cumulative.
 - 2. Maximum Offset From True Alignment Between Adjacent Members Butting or In-Line: +/- 1/32 inch.

3.04 CLEANING AND PROTECTION

- A. Following completion of installation, clean all surfaces. Use cleaning materials and procedures recommended by glazing support system manufacturer.

--- END ---

**SECTION 08 80 00
GLAZING**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies glass, related glazing materials and accessories. Glazing products specified apply to factory or field glazed items.

1.02 RELATED WORK

- A. Structural glazing support system: Section 08 44 23, GLAZING SUPPORT SYSTEM.
B. Patterned glass: Section 09 06 00, SCHEDULE OF FINISHES.

1.03 LABELS

- A. Temporary labels:
1. Provide temporary label on each light of glass identifying manufacturer or brand and glass type, quality and nominal thickness.
2. Label in accordance with NFRC (National Fenestration Rating Council) label requirements.
3. Temporary labels shall remain intact until glass is approved by Contracting Officer's Representative (COR).
- B. Permanent labels:
1. Locate in corner for each pane.
2. Label in accordance with ANSI Z97.1 and SGCC (Safety Glass Certification Council) label requirements.
a. Tempered glass.
b. Laminated glass or have certificate for panes without permanent label.
c. Organic coated glass.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Design glazing system consistent with guidance and practices presented in the GANA Glazing Manual, GANA Laminated Glazing Manual, and GANA Sealant Manual, as applicable to project. Installed glazing is to withstand applied loads, thermal stresses, thermal movements, building movements, permitted tolerances, and combinations of these conditions without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; unsafe engagement of the framing system; deflections beyond specified limits; or other defects in construction.
- B. Glazing Unit Design: Design glass, including engineering analysis meeting requirements of authorities having jurisdiction. Thicknesses listed are minimum. Coordinate thicknesses with support system manufacturers:
1. Design glass in accordance with ASTM E1300, and for conditions beyond the scope of ASTM E1300, by a properly substantiated structural analysis.
2. Design Wind Pressures: As indicated on construction documents.
3. Wind Design Data: As indicated on construction documents.
4. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.

1.05 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Warranty: Submit written guaranty, conforming to General Condition requirements, and to "Warranty of Construction" Article in this Section.
- C. Manufacturer's Literature and Data:
 - 1. Glass, each kind required.
 - 2. Sealing compound.
- D. Shop Drawings: (1/2 full scale) showing construction, anchorage, reinforcement, and installation details.
- E. Samples: Two (2) samples of 305 mm by 305 mm (12 inches by 12 inches).
 - 1. Patterned Laminated glass.
- F. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer's test report indicating glazing sealants were tested for adhesion to glass and for compatibility with glass and other glazing materials.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.
- B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.
- C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Field measure openings before ordering glass products. Be responsible for proper fit of field measured products.
- B. Environmental Requirements: Perform glazing Work on dry surfaces only, and when temperature in installation area is above 40-degrees F.

1.08 WARRANTY

- A. Warranty: Conform to terms of "Warranty of Construction", FAR clause 52.246-21.
- B. Manufacturer Warranty: Manufacturer shall warranty their glazing from the date of installation and final acceptance by the Government as follows. Submit manufacturer warranty.
 - 1. Laminated glass units to remain laminated for five (5) years.

1.09 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American National Standards Institute (ANSI):
 - Z97.1-09 Safety Glazing Material Used in Building - Safety Performance Specifications and Methods of Test.
- C. American Society for Testing and Materials (ASTM):
 - C794-10 Adhesion-in-Peel of Elastomeric Joint Sealants.
 - C864-05(2011) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - C920-14a Elastomeric Joint Sealants.
 - C1036-11e1 Flat Glass.
 - C1048-12e1 Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
 - C1172-14 Laminated Architectural Flat Glass.
 - C1363-11 Thermal Performance of Building Assemblies, by Means of A Hot Box Apparatus.
 - C1376-10 Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - D635-10 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastic in a Horizontal Position.
 - E84-14 Surface Burning Characteristics of Building Materials.
 - E119-14 Standard Test Methods for Fire Test of Building Construction and Material.
- D. Code of Federal Regulations (CFR):
 - 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; 2010.
- E. National Fenestration Rating Council (NFRC)
- F. Safety Glazing Certification Council (SGCC) 2012:
 - Certified Products Directory (Issued Semi-Annually).
- G. Glass Association of North America (GANA):
 - Glazing Manual (Latest Edition)
 - Sealant Manual (Latest Edition)
 - Laminated Glazing Reference Manual
- H. U.S. Veterans Administration:
 - Physical Security Design Manual for VA Facilities (VAPSDG); Life Safety Protected.
 - Physical Security Design Manual for VA Facilities (VAPSDG); Mission Critical Facilities
 - Architectural Design Manual for VA Facilities (VASDM)

PART 2 – PRODUCT

2.01 GLASS

- A. Provide minimum thickness stated and as additionally required to meet performance requirements.
 - 1. Provide minimum 12 mm (1/2 inch) thick glass units unless otherwise indicated.
- B. Obtain glass units from single source from single manufacturer for each glass type.

- C. Use thickness stated unless specified otherwise in assemblies.
- D. Clear Glass:
 - 1. ASTM C1036, Type I, Class 1, Quality q3.

2.02 HEAT-TREATED GLASS

- A. Roller Wave Limits for Heat-Treated Glass: Orient all roller wave distortion parallel to bottom surface of glazing, and provide units complying with the following limitations:
 - 1. Measurement Parallel to Line: Maximum peak to valley 0.203 mm (0.008 inch).
 - 2. Measurement Perpendicular to Line: Maximum 0.0254 mm (0.001 inch).
 - 3. Bow/Warp: Maximum 50 percent of bow and warp allowed by ASTM C1048.
- B. Clear Heat Strengthened Glass:
 - 1. ASTM C1048, Kind HS, Condition A, Type I, Class 2, Quality q3.
 - 2. Thickness, 12 mm (1/2 inch) and as indicated.
- C. Clear Tempered Glass:
 - 1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
 - 2. Thickness, 19 mm (3/4 inch) and as indicated.

2.03 COATED GLASS

- A. Ceramic Coated Vision Glass:
 - 1. ASTM C1048, Kind HS, Condition C, Type I, Quality q3 with ceramic coating applied by silk-screen process.
 - 2. Pattern as specified in Spec Section 09 06 00 SCHEDULE OF FINISHES.
 - 3. Thickness, 12 mm (1/2 inch) and as indicated.

2.04 LAMINATED GLASS

- A. Laminated Glass: ASTM C1172. Two or more lites of glass bonded with polyvinyl butyral interlayer complying with interlayer manufacturer's written instructions.
- B. Interlayer: Use 1.5 mm (0.060 inch) thick interlayer for horizontal or sloped glazing.
 - 1. Interlayer Color: Clear.

2.05 GLAZING ACCESSORIES

- A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work shall have a finish that will not corrode or stain while in service.
- B. Structural Sealant: ASTM C920, silicone acetoxycure:
 - 1. Type S.
 - 2. Class 25.
 - 3. Grade NS.
- C. Color:
 - 1. Color of other glazing sealants which will be exposed in the finished work and unpainted are to be neutral color.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Verify that reinforcement and anchoring devices are the correct type, have been located correctly, and have been installed properly.
 - 2. Coordinate with Structural Glazing Support System and verify that glazing conform with details, dimensions and tolerances indicated on manufacturer's approved shop drawings.
- B. Advise Contractor of conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation: Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Inspect each piece of glass immediately prior to start of installation. Do not install items which are improperly sized, have damaged edges, or are scratched, abraded, or deficient in any other manner.

3.02 PREPARATION

- A. For sealant glazing, prepare glazing surfaces in accordance with GANA-02 Sealant Manual.
- B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.
- C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.
- D. Verify that components used are compatible.
- E. Clean and dry glazing surfaces.

3.03 INSTALLATION – GENERAL

- A. Install in accordance with GANA-01 Glazing Manual and GANA-02 Sealant Manual unless specified otherwise.
- B. Glaze in accordance with recommendations of glazing and Structural Glazing Support manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.
- C. Set glazing without bending, twisting, or forcing of units.
- D. Do not allow glass to rest on or contact any framing member.
- E. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.
- F. Laminated Glass:
 - 1. Tape edges to seal interlayer and protect from glazing sealants.
 - 2. Do not use putty or glazing compounds.

3.06 REPLACEMENT AND CLEANING

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by COR.
- B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.
- C. Leave glass in clean, whole, and acceptable condition.

3.07 PROTECTION

- A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

3.08 GLAZING TYPES

- A. Refer to Drawings for glazing location.
- B. Glass Type GL-1: Patterned Laminated Glass, Nominal thickness 1 1/16-inch total, consisting of one (1) layer of 1/2-inch thick, clear, heat strengthened glass with Viraspan Screen No. 3058 with Simulated Sandblast V1086 on No. 2 surface; a clear color interlayer of polyvinyl butyral (PVB) of minimum 0.060-inch thickness; one (1) layer of 1/2-inch thick, clear, heat strengthened glass with Viraspan Wavy Line Screen No. 20829 with High Opacity White V175 on No. 3 surface.
- C. Glass Type GL-2: Tempered Glass: Clear, 3/4-inch thick, fully tempered.

--- E N D ---

**SECTION 09 06 00
SCHEDULE FOR FINISHES**

PART I – GENERAL

1.01 DESCRIPTION

- A. This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

1.02 MANUFACTURERS

- A. Manufacturer’s trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer’s equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

1.03 SUBMITALS

- A. Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES-provide quadruplicate samples for color approval of materials and finishes specified in this section.

1.04 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
- B. MASTER PAINTING INSTITUTE: (MPI)
2012Architectural Painting Specification Manual

PART 2 – PRODUCTS

2.01 DIVISION 04 MASONRY

- A. SECTION 04 05 13, MASONRY MORTARING and SECTION 04 05 16, MASONRY GROUTING

Location	Manufacturer	Mfg. Color Name
Face Brick		To match existing adjacent CMU
CMU		To match existing adjacent face brick

- B. SECTION 04 20 00, UNIT MASONRY

1. Face Brick				
Finish Code	Size	Pattern	Manufacturer	Mfg. Color Name/No.
	To match existing adjacent face brick	To match existing adjacent face brick	To match existing adjacent face brick	To match existing adjacent face brick

2. Concrete Masonry Unit (CMU)				
Type	Size	Pattern	Finish	Mfg. Color Name/No.

CMU Standard	To match existing adjacent CMU	To match existing adjacent CMU	To match existing adjacent CMU	To match existing adjacent CMU
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2.02 DIVISION 05 METALS

A. SECTION 05 12 00, STRUCTURAL STEEL FRAMING

Component	Finish	Color
Canopy steel structure	P-1, Gloss Level 5	To be determined
Glass guardrail and barrier support steel plates and miscellaneous steel	P-2, Gloss Level 5	To be determined

B. SECTION 05 50 00, METAL FABRICATIONS

Location	Component / Material / Size / Thickness	Finish / Color
(E) Grand Stair 003	Handrails / Stainless Steel / Size to match (E) handrail size / Schedule 40 minimum	Finish to match (E) stainless steel handrail finish
(E) Second Floor Balcony	Angle Supports at Glass Barrier / Steel / Sizes as shown	P-2, Gloss Level 5 / Color to be determined

C. SECTION 05 58 13, FORMED METAL COLUMN COVERS

Component	Finish Material	Manufacturer / Mfr. System Name	Mfr. Finish System / Color
Column Cover	Aluminum	CENTRIA / Column Cover Series 2000	CENTRIA Duraguard Plus / Color to be selected from Manufacturer's Standard

2.03 DIVISION 07 THERMAL AND MOISTURE PROTECTION

A. SECTION 07 60 00, FLASHING AND SHEET METAL

Item	Material	Finish
Flashings	Aluminum	P-1, Gloss Level 5
Gutters	Galvanized Steel	Prime coat over phosphate coating
Conductors (Downspouts)	Galvanized Steel	Prime coat over phosphate coating

2.04 DIVISION 08 – OPENINGS

A. SECTION 08 80 00, GLAZING

Glazing Type	Thickness / Description	Manufacturer / Mfg. Style/Color Name / No.
GL-1	1 1/16-inch / Laminated Pattern Glass	Viracon / Viraspan Screen No. 3058 with V1086 – Simulated Sandblast on No. 2 Surface and Viracon / Viraspan Screen No. 20829 with V175 – High Opacity White on No. 3 Surface
GL-2	3/4-inch / Tempered Glass	Clear

B. SECTION 08 44 23, GLAZING SUPPORT SYSTEMS

Component / Location	Material	Manufacturer	Mfr. System Name/No. / Finish
Heavy Duty Single Arm Spider Fitting / Glass Canopy	Stainless Steel	C.R. Laurence	CRL Single Arm Heavy-Duty Post Mount Fitting /PMH1BS / Brushed
			CRL Double Arm Heavy – Duty Post Mount Fitting / PMH2BS / Brushed
Heavy Duty Double Arm Spider Fitting / Glass Barrier	Stainless Steel	C.R. Laurence	CRL Double Arm “V” Heavy – Duty Wall/Fin Mount Fitting / FMH2VBS / Brushed
Heavy Duty Double Arm Spider Fitting / Glass Guardrail	Stainless Steel	C.R. Laurence	CRL Double Arm “V” Heavy – Duty Wall/Fin Mount Fitting / FMH2VBS / Brushed

2.05 DIVISION 09 – FINISHES

A. SECTION 09 65 13, RESILIENT BASE AND ACCESSORIES

Finish Code	Item	Height / Type	Manufacturer	Mfg Name/No. / Color Name/No.
RB-1	Rubber Base	4-inch/ Continuous Roll Straight Profile	Johnsonite, Inc.	Traditional Wall Base / DC-XX with toe / Color to be selected from Manufacturer’s Standard Colors

B. SECTION 09 91 00, PAINT AND COATINGS

1. MPI Gloss and Sheen Standards

Gloss Level 1	a traditional matte finish-flat	max 5 units, and	max 10 units
Gloss Level 2	a high side sheen flat-“a velvet-like” finish	max 10 units, and	10-35 units
Gloss Level 3	a traditional “egg-shell like” finish	10-25 units, and	10-35 units
Gloss Level 4	a “satin-like” finish	20-35 units, and	min. 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	
Gloss Level 7	a high gloss	more than 85 units	

2. Paint code (P)	Description / Gloss Level	Manufacturer	Mfg. Color Name / No.
P-1	Typical field color on all exterior canopy steel structure and miscellaneous galvanized steel and aluminum surfaces / Gloss Level 5	Dunn Edwards	Color to be selected
P-2	Typical field color paint for all interior gypsum wallboard surfaces, unless otherwise noted / Gloss Level 3	Kelly-Moore	Color to be selected

	Typical field color paint for all interior glass guardrail and barrier support steel plates and all associated exposed plates and angles, unless otherwise noted / Gloss Level 5	Kelly-Moore	Color to be selected
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2.06 DIVISION 10 – SPECIALITIES

A. SECTION 10 26 00, WALL PROTECTION

Item Type	Material	Manufacturer / Style	Mfg. Model / Color Name & No.
Wall Protection System	Vinyl/Acrylic	Construction Specialties / Acrovyn Saratoga	Chameleon Simulated Wood and Metal / Color to be selected from Manufacturer's standard colors to match existing hardwood wall base

2.07 DIVISION 12 – FURNISHINGS

A. SECTION 12 32 00, MANUFACTURED WOOD CASEWORK

Item Type	Finish	Manufacturer / Collection	Color Pattern / Name/No.
Upper Cabinets	Wood Veneer / Medium Color Stain	Sherwin Williams	Stain color to match existing base cabinets color and sheen

PART 3 - EXECUTION

3.01 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Access Flooring	AF
Acoustical Ceiling	AT
Carpet Module Tile	CPT
Ceramic Mosaic Tile	CT
Concrete	C
Epoxy Coating	EC
Existing	E
Exposed Divider Strips	EXP
Feature Strips	FS
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT
Gypsum Wallboard	GWB
High Glazed Coating	SC
Latex Mastic Flooring	LM

Linoleum Tile	LT
Material	MAT
Mortar	M
Multi-Color Coating	MC
Natural Finish	NF
Paint	P
Paver Tile	PVT
Plastic Laminate	HPDL
Porcelain Paver Tile	PPT
Rubber Base	RB
Spandrel Glass	SLG
Stain	ST
Suspension Decorative Grids	SDG
Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF
Wood	WD

3.02 FINISH SCHEDULE SYMBOLS

Symbol Definition

**	Same finish as adjoining walls
-	No color required
E	Existing
XX	To match existing
EFTR	Existing finish to remain
RM	Remove

3.03 ROOM FINISH SCHEDULE

- A. Match adjoining or existing similar surfaces colors, textures or patterns where disturbed or damaged by alterations or new work when not scheduled.

--- E N D ---

**SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies steel studs wall systems, fasteners, and accessories for the screw attachment of gypsum board or other building boards.

1.02 RELATED WORK

- A. Support for wall mounted items: Section 05 50 00, METAL FABRICATIONS.
- B. Gypsum board panels: Section 09 29 00, GYPSUM BOARD.

1.03 TERMINOLOGY

- A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.
- B. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

1.04 QUALITY ASSURANCE

- A. Allowable Tolerances:
 - 1. Walls and Partitions: Limit tolerances for bow and alignment to 1/8-inch in 10-feet in both vertical and horizontal directions.
- B. Each stud shall have a label or stamp at maximum 48-inch on center, indicating the manufacturer's name, logo or initials, ICC Evaluation Service, Inc., evaluation report number, material thickness and yield strength.

1.05 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

- A. In accordance with the requirements of ASTM C754.
- B. Store materials indoors in a dry area, off the floor, protected from weather, direct sunlight, surface contamination, corrosion, and construction traffic, and stacked flat to prevent sagging. Do not overload floor system.
- C. Remove items delivered in a broken, damaged, rusted, or unlabeled condition from the Project Site immediately.
- D. Additionally store and handle materials in accordance with the "Code of Standard Practice for Cold-Formed Steel Structural Framing," as published by the AISI.

1.06 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society For Testing And Materials (ASTM)
A123/A123M-13Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

A653/A653M-13	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
A641-09a	Zinc-Coated (Galvanized) Carbon Steel Wire
C11-13	Terminology Relating to Gypsum and Related Building Materials and Systems
C645-14	Non-Structural Steel Framing Members
C754-11	Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
C841-03(2013)	Installation of Interior Lathing and Furring
C954-11	Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
C1002-14	Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

- C. International Code Council (ICC) evaluation report, "Acceptance Criteria for Steel Studs and Joists," and ICC ER 4943P.

PART 2 - PRODUCTS

2.01 PROTECTIVE COATING

- A. Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G-60 minimum, per ASTM 123.

2.02 STEEL STUDS AND RUNNERS (TRACK)

- A. ASTM C645, modified for thickness specified and sizes as shown.
1. Cold-formed galvanized steel.
 2. Use ASTM A525 steel, 1.4 mm (0.0538-inch) thick bare metal (54 mil), 16-gauge minimum.
- B. Studs:
1. Cold-formed galvanized steel.
 2. 16 gauge minimum.
 3. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.
 4. Studs 3600 mm (12 feet) or less in length shall be in one piece.
- C. Tracks:
1. Cold-formed galvanized steel.
 2. 16 gauge minimum, or be heavier than stud used.
 3. Deep leg, unpunched, rust inhibitive primer.

2.03 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES

- A. ASTM C754, except as otherwise specified.

- B. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.
- C. Welding Electrodes: AWS low hydrogen type, as required.

PART 3 - EXECUTION

3.01 INSTALLATION CRITERIA

- A. Install Work in accordance with the applicable requirements of SSMA, AWS and ASTM C754.
- B. Framing and furring Work shall be plumb, straight, true and rigid.
- C. Stud sizes and spacing as shown on the Drawings are minimum requirements. In no case shall stud sizes and spacing be less than that recommended by the manufacturer's structural calculations.
- D. Provide welded, bolted or screwed connections as shown or as required.

3.02 INSTALLING TRACKS

- A. Fasten tracks as shown on Drawings. Secure vertical studs in floor tracks with sheet metal screws to suit stud gauge. Provide welded, bolted or screwed connections as shown or required. Align top and bottom tracks.

3.03 INSTALLING STUDS

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
- B. Space studs not more than 400 mm (16 inches) on center.

3.04 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES

- A. Provide for attachment and support of wall-hung casework, and other items supported by stud construction.
- B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

3.05 CLEANING

- A. Clean metal support systems of dirt, grease, trash, adhesives, or adhering foreign materials prior to installation of materials to be installed therein.

--- E N D ---

**SECTION 09 29 00
GYPSUM BOARD**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies installation and finishing of gypsum board.

1.02 RELATED WORK

- A. Installation of steel framing members for walls, partitions, furring: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
- B. Painting: Section 09 91 00, PAINTING.

1.03 TERMINOLOGY

- A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.

1.04 QUALITY ASSURANCE

- A. Each type of gypsum board throughout the Project, including accessories and fasteners, shall be the product of a single manufacturer.
- B. Codes and Standards: Work shall comply with the applicable requirements of the latest addition of Gypsum Association Publication GA-216, "Recommended Specifications for the Application and Finishing of Gypsum Board."
- C. Construction Tolerances:
 - 1. Gypsum board surfaces shall have no measurable variation in any 2-foot direction and a maximum variation of 1/8-inch in 10-foot when a straight edge is laid on the surface in any direction.
 - 2. Shim Work as required to comply with specified tolerances.

1.05 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

- A. In accordance with the requirements of ASTM C840.
- B. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- C. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.06 ENVIRONMENTAL CONDITIONS

- A. In accordance with the requirements of ASTM C840.
- B. Temperature: Maintain minimum 50 degrees F for 48 hours before application and finishing of gypsum board. Maintain temperature continuously until dry. Do not exceed 95 degrees F when using temporary heat sources.

- C. Ventilation:
 - 1. Provide ventilation during and following joint treatment applications.
 - 2. Use temporary air circulators in enclosed areas lacking natural ventilation.
 - 3. Under slow drying conditions, allow additional drying time between coats of joint treatment.
 - 4. Protect installed materials from drafts during hot, dry weather.

1.07 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing And Materials (ASTM):
 - C11-13 Terminology Relating to Gypsum and Related Building Materials and Systems
 - C475/C475M-12..... Joint Compound and Joint Tape for Finishing Gypsum Board
 - C840-13 Application and Finishing of Gypsum Board
 - C954-11 Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness
 - C1002-14 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 - C1047-14a Accessories for Gypsum Wallboard and Gypsum Veneer Base
 - C1396/C1396M-14a..... Gypsum Board
 - E84-14..... Surface Burning Characteristics of Building Materials
- C. Underwriters Laboratories Inc. (UL):
 - Latest Edition Fire Resistance Directory
- D. Inchcape Testing Services (ITS):
 - Latest Editions..... Certification Listings

PART 2 - PRODUCTS

2.01 GYPSUM BOARD

- A. Gypsum Board: ASTM C1396, Type X, fire-resistive core, 16 mm (5/8 inch) thick unless shown otherwise. Tapered edges. Shall contain a minimum of 20 percent recycled gypsum.
- B. Gypsum cores shall contain a minimum of 95 percent post industrial recycled gypsum content. Paper facings shall contain 100 percent post-consumer recycled paper content.

2.02 ACCESSORIES

- A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.
- B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.
- C. Corner Beads, Casing Beads, Metal Trim, Edge Trim and other metal accessories: ASTM C840, zinc-coated (galvanized) steel, size to suit board thickness.

2.03 FASTENERS

- A. ASTM C1002 and ASTM C840, except as otherwise specified.
- B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).
- C. Select screws of size and type recommended by the manufacturer of the material being fastened.
- D. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

2.04 FINISHING MATERIALS AND LAMINATING ADHESIVE

- A. ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.
- B. Joint Treatment: Joint tape and joint compound for embedding and finishing shall be products of one (1) manufacturer and in conformance with ASTM C475.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify that all framing, and required backing are complete, that framing is accurately spaced and aligned, and that spacing does not exceed maximum allowable for thickness of gypsum board to be used. Correct framing members out of alignment, bowed or warped to provide true, plumb surfaces before applying gypsum board. Obtain acceptance of method of correction prior to start of Work.
- B. If unsatisfactory conditions exist, do not proceed with gypsum board application until such conditions have been corrected.

3.02 INSTALLING GYPSUM BOARD

- A. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
- B. Work shall comply with all applicable requirements of GA-216, except where more stringent requirements are specified herein, by Codes, or by installation instructions from the manufacturer of gypsum board.
- C. Coordinate installation of gypsum board with other trades and related work.
- D. Use gypsum boards in maximum practical lengths to minimize number of end joints.
- E. Bring gypsum board into contact, but do not force into place.
- F. Walls:
 - 1. When gypsum board is installed parallel to framing members, space fasteners 300 mm (12 inches) on center in field of the board, and 200 mm (8 inches) on center along edges.
 - 2. When gypsum board is installed perpendicular to framing members, space fasteners 300 mm (12 inches) on center in field and along edges.
 - 3. Stagger screws on abutting edges or ends.

4. Install gypsum board within 1/4-inch of penetrating ducts, pipes, conduits, outlet boxes, and other penetrating items.
 5. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.
 6. No offset in exposed face of walls and partitions will be permitted because of single-ply application requirements.
- G. Accessories:
1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
 2. Install in one piece, without the limits of the longest commercially available lengths.
 3. Corner Beads:
 - a. Install at all vertical and horizontal external corners and where shown.
 - b. Use screws only. Do not use crimping tool.
 4. Edge Trim (casings Beads):
 - a. At both sides of expansion and control joints.
 - b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
 - c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
 - d. Where shown.

3.03 FINISHING OF GYPSUM BOARD

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for all finished areas open to public view.
- B. Before proceeding with installation of finishing materials, assure the following:
 1. Gypsum board is fastened and held close to framing or furring.
 2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.
- C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non-decorated smoke barrier, fire rated and sound rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the smoke barrier, fire rated and sound rated construction. Sanding is not required of non-decorated surfaces.

3.04 REPAIRS

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.
- B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.

- D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction, and STC equivalent to the sound rated construction.

--- E N D ---

**SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section specifies the installation of resilient base and accessories.

1.02 RELATED WORK

- A. Color and texture: Section 09 06 00, SCHEDULE FOR FINISHES.
B. Gypsum wallboard: Section 09 29 00, GYPSUM BOARD.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Description of each product.
 2. Base material manufacturer's recommendations for adhesives.
 3. Application and installation instructions.
 4. MSDS (Material Safety Data Sheets) for adhesives and cleaning agents. Include compliance with VOC limits.
- C. Samples:
1. Submit manufacturer's complete color selections for each specified product type for initial selection.
 2. Base: Two (2) samples of 150 mm (6 inches) long, each selected type and color.
 3. Adhesive: Literature indicating each type.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.
- B. Materials from containers which have been distorted, damaged or opened prior to installation will be rejected.
- C. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 55-degree F (13-degree C) or more than 85-degree F (29-degree C).
- D. Protect material from damage by handling and construction operations before, during, and after installation.

1.05 PROJECT CONDITIONS

- A. Do not install materials until wet construction is complete, dry, and cured.
- B. Install resilient products after other finishing operations, including painting, have been

completed.

- C. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65-degree F (18-degree C) or more than 85-degree F (29-degree C) in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- D. Maintain the ambient relative humidity between 40 percent and 60 percent during installation.

1.06 APPLICABLE PUBLICATIONS

- A. The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
F1861-08(2012)e1 Resilient Wall Base

PART 2 – PRODUCTS

2.01 GENERAL

- A. Use only products by the same manufacturer and from the same production run.

2.02 RESILIENT BASE

- A. ASTM F1861, 3 mm (1/8 inch) thick, 100 mm (4 inches) high, unless otherwise noted, Type TP Rubber, Thermoplastics, Group 1-layered, Continuous roll.
 - 1. Style A-straight (RB-1), typical wall base.
- B. Provide pre-molded corners. Style, height and color to match adjacent base.

2.03 INSTALLATION MATERIALS

- A. Use products recommended by the material manufacturer for the conditions of use.
- B. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based formulation.
- C. Use low-VOC adhesive during installation. Water based adhesive with low VOC is preferred over solvent based adhesive.

PART 3 – EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. The respective manufacturer's instructions for application and installation will be considered for use when approved by the Contracting Officer's Representative (COR).
- B. Submit proposed installation deviation from this specification to the COR indicating the differences in the method of installation.

- C. The COR reserves the right to have test portions of material installation removed to check for non-uniform adhesion and spotty adhesive coverage.

3.02 EXAMINATION

- A. Examine substrates, with installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient wall base.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Grind, sand, or cut away protrusions.
- D. Substrate area dry and cured.
- E. Clean substrate area of oil, grease, dust, paint, and deleterious substances.
- F. Vacuum clean substrates to be covered by resilient products immediately before installation.
- G. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

3.04 BASE INSTALLATION

- A. Location:
 - 1. Unless otherwise specified or shown, where base is scheduled, install base to walls where base is required.
- B. Application:
 - 1. Comply with manufacturer's written instructions for installing resilient base.
 - 2. Apply adhesive uniformly with no bare spots. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 3. Set base with joints butted without gaps at seams and to touch for entire height; align tops of adjacent pieces of bases.
 - 4. Install resilient base in lengths as long as practicable. Before starting installation, layout base material to provide the minimum number of joints with no strip less than 600 mm (24 inches) length.
 - a. Short pieces to save material will not be permitted.
 - b. Locate joints as remote from corners as the material lengths or the wall configuration will permit.
 - 5. Do not stretch resilient base during installation.

6. Install preformed corners at internal and external corners. Install end stops at exposed ends of base.
- C. Roll base for complete adhesion.

3.05 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Clean and polish materials in the following order:
 1. After two weeks, scrub resilient base materials with a minimum amount of water and a mild detergent. Leave surfaces clean and free of detergent residue. Polish resilient base to a gloss finish.
- E. Immediately prior to acceptance, replace damaged materials and re-clean resilient materials. Damaged materials are defined as having cuts, gouges, scrapes or tears and not fully adhered.

--- E N D ---

**SECTION 09 91 00
PAINTING**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the construction documents and/or specified herein, including, but not limited to, the following:
1. Prime coats which may be applied in shop under other sections.
 2. Prime painting unprimed surfaces to be painted under this Section.
 3. Painting items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged or rusted prime coats applied by others.
 4. Painting ferrous metal (except stainless steel) exposed to view.
 5. Painting galvanized ferrous metals exposed to view.
 6. Painting gypsum drywall exposed to view.
 7. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.
 8. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
 9. Painting of any surface not specifically mentioned to be painted herein or on construction documents, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, is to be included as though specified.

1.02 RELATED WORK

- A. Activity Hazard Analysis: Section 01 35 26, SAFETY REQUIREMENTS.
- B. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 07 – THERMAL AND MOISTURE PROTECTION, Division 08 - OPENINGS, Division 09 – FINISHES, Division 12 – FURNISHINGS, Division 13 – SPECIAL CONSTRUCTION, and Division 26 - ELECTRICAL sections.
- C. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.

- C. Sample Panels:
 - 1. After painters' materials have been approved and before work is started submit sample panels showing each type of finish and color specified.
 - 2. Panels to show color: Composition board, 100 by 250 by 3 mm (4 inch by 10 inch by 1/8 inch).
 - 3. Panel to show transparent finishes: Wood of same species and grain pattern as wood approved for use, 100 by 250 by 3 mm (4 inch by 10 inch face by 1/4 inch) thick minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 by 50 mm (2 by 2 inch) minimum or actual wood member to show complete finish.
 - 4. Attach labels to panel stating the following:
 - a. Federal Specification Number or manufacturers name and product number of paints used.
 - b. Specification code number specified in Section 09 06 00, SCHEDULE FOR FINISHES.
 - c. Product type and color.
 - d. Name of project.
 - 5. Strips showing not less than 50 mm (2 inch) wide strips of undercoats and 100 mm (4 inch) wide strip of finish coat.
- D. Painter qualifications.
- E. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.

1.04 DELIVERY AND STORAGE

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
 - 1. Name of manufacturer.
 - 2. Product type.
 - 3. Batch number.
 - 4. Instructions for use.
 - 5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
 - 1. Federal Specification Number, where applicable, and name of material.
 - 2. Surface upon which material is to be applied.
 - 3. If paint or other coating, state coat types; prime, body or finish.
- C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

1.05 QUALITY ASSURANCE

- A. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces. Submit evidence that key personnel have successfully performed surface preparation and application of coating on a minimum of three (3) similar projects within the past three (3) years.

- B. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Contracting Officer Representative (COR) in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

1.06 MOCK-UP PANEL

- A. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 3.05 m (10 feet) wide, floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the COR. Paint mock-ups to include one (1) door and frame assembly.
- B. Finish and texture approved by COR will be used as a standard of quality for remainder of work.
- C. Repaint individual areas which are not approved, as determined by the COR, until approval is received.

1.07 REGULATORY REQUIREMENTS

- A. Paint materials are to conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
- B. Lead-Base Paint:
 - 1. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
 - 2. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
 - 3. Do not use coatings having a lead content over 0.06 percent by weight of non-volatile content.
- C. Asbestos: Provide materials that do not contain asbestos.
- D. Chromate, Cadmium, Mercury, and Silica: Provide materials that do not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
- E. Human Carcinogens: Provide materials that do not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
- F. Use high performance acrylic paints in place of alkyd paints.

1.08 SAFETY AND HEALTH

- A. Apply paint materials using safety methods and equipment in accordance with the following:
- B. Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis (AHA) as specified

in Section 01 35 26, SAFETY REQUIREMENTS. The AHA is to include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

- C. Safety Methods Used During Paint Application: Comply with the requirements of SSPC PA Guide 10.
- D. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
 - 1. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
 - 2. 29 CFR 1910.1000.
 - 3. ACHIH-BKLT and ACGHI-DOC, threshold limit values.

1.09 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):
 - ACGIH TLV-BKLT-2012..... Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
 - ACGIH TLV-DOC-2012..... Documentation of Threshold Limit Values and Biological Exposure Indices, (Seventh Edition)
- C. ASME International (ASME):
 - A13.1-07(R2013)..... Scheme for the Identification of Piping Systems
- D. Code of Federal Regulation (CFR):
 - 40 CFR 59..... Determination of Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coating
- E. Commercial Item Description (CID):
 - A-A-1272A..... Plaster Gypsum (Spackling Compound)
- F. Federal Specifications (Fed Spec):
 - TT-P-1411A..... Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls) (CEP)
- G. Master Painters Institute (MPI):
 - 1 Aluminum Paint (AP)
 - 4 Interior/ Exterior Latex Block Filler
 - 11 Exterior Latex, Semi-Gloss
 - 18 Organic Zinc Rich Primer
 - 31 Polyurethane, Moisture Cured, Clear Gloss
 - 45 Interior Primer Sealer
 - 46 Interior Enamel Undercoat
 - 50 Interior Latex Primer Sealer
 - 52 Interior Latex, MPI Gloss Level 3
 - 53 Interior Latex, Flat, MPI Gloss Level 1
 - 54 Interior Latex, Semi-Gloss, MPI Gloss Level 5
 - 71 Polyurethane, Moisture Cured, Clear, Flat
 - 90 Interior Wood Stain, Semi-Transparent
 - 94 Exterior Alkyd, Semi-Gloss

- 95 Fast Drying Metal Primer
 - 134 Waterborne Galvanized Primer
 - 135 Non-Cementitious Galvanized Primer
 - 138 Interior High Performance Latex, MPI Gloss Level 2
 - 139 Interior High Performance Latex, MPI Gloss Level 3
 - 140 Interior High Performance Latex, MPI Gloss Level 4
 - 141-07 Interior High Performance Latex (SG) MPI Gloss Level 5
- H. Steel Structures Painting Council (SSPC):
- SSPC SP 1..... Solvent Cleaning
 - SSPC SP 2..... Hand Tool Cleaning
 - SSPC SP 3..... Power Tool Cleaning
 - SSPC SP 10/NACE No.2 Near-White Blast Cleaning
 - SSPC PA Guide 10 Guide to Safety and Health Requirements
- I. U.S. National Archives and Records Administration (NARA):
- 29 CFR 1910.1000..... Air Contaminants
- J. Underwriter's Laboratory (UL)

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Plastic Tape:
- 1. Pigmented vinyl plastic film in colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES or specified.
 - 2. Pressure sensitive adhesive back.
 - 3. Widths as shown.
- B. Identity markers options:
- 1. Pressure sensitive vinyl markers.
 - 2. Snap-on coil plastic markers.
- C. Aluminum Paint (AP): MPI 1.
- D. Exterior Latex, Semi-Gloss (AE): MPI 11.
- E. Organic Zinc rich Coating (HR): MPI 18.
- F. Interior Primer Sealer: MPI 45.
- G. Interior Enamel Undercoat: MPI 46.
- H. Interior Latex Primer Sealer: MPI 50.
- I. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
- J. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.
- K. Polyurethane, Moisture Cured, Clear, Flat (PV): MPI 71.
- L. Interior Wood Stain, Semi-Transparent (WS): MPI 90.

- M. Wood Filler Paste: MPI 91.
- N. Fast Drying Metal Primer: MPI 95.
- O. Waterborne Galvanized Primer: MPI 134.
- P. Non-Cementitious Galvanized Primer: MPI 135.
- Q. Interior High Performance Latex, MPI Gloss Level 2(LF): MPI 138.
- R. Interior High Performance Latex, MPI Gloss Level 3 (LL): MPI 139.
- S. Interior High Performance Latex, MPI Gloss Level 4: MPI 140.
- T. Interior High Performance Latex (SG), MPI Gloss Level 5: MPI 141.

2.02 PAINT PROPERTIES

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

2.03 REGULATORY REQUIREMENTS/QUALITY ASSURANCE

- A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
 - 1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 10g/l for interior latex paints/primers and 50g/l for exterior latex paints and primers.
 - 2. Lead-Base Paint:
 - a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
 - b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
 - 3. Asbestos: Materials shall not contain asbestos.
 - 4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
 - 5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
 - 6. Use high performance acrylic paints in place of alkyd paints, where possible.
 - 7. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydro carbons by weight.

PART 3 – EXECUTION

3.01 JOB CONDITIONS

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
 - 1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
 - 2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each days work.

- B. Atmospheric and Surface Conditions:
 - 1. Do not apply coating when air or substrate conditions are:
 - a. Less than 3 degrees C (5 degrees F) above dew point.
 - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
 - 2. Maintain interior temperatures until paint dries hard.
 - 3. Do no exterior painting when it is windy and dusty.
 - 4. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
 - 5. Apply only on clean, dry and frost free surfaces except as follows:
 - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.
 - b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.
 - 6. Varnishing:
 - a. Apply in clean areas and in still air.
 - b. Before varnishing vacuum and dust area.
 - c. Immediately before varnishing wipe down surfaces with a tack rag.

3.02 SURFACE PREPARATION

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.

- B. General:
 - 1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
 - 2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
 - 3. See other sections of specifications for specified surface conditions and prime coat.
 - 4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

- C. Ferrous Metals:
 - 1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
 - 2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning).
 - 3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, and similar items specified to have semi-

- gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
- a. This includes flat head countersunk screws used for permanent anchors.
 - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
 5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.
- D. Zinc-Coated (Galvanized) Metal Surfaces Specified Painted:
1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
 2. Spot coat abraded and damaged areas of zinc-coating which expose base metal on hot-dip zinc-coated items with MPI 18 (Organic Zinc Rich Coating). Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non- Cementitious Galvanized Primer) depending on finish coat compatibility.
- E. Gypsum Board:
1. Remove efflorescence, loose and chalking plaster or finishing materials.
 2. Remove dust, dirt, and other deterrents to paint adhesion.
 3. Fill holes, cracks, and other depressions with CID-A-A-1272A [Plaster, Gypsum (Spackling Compound) finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 25 mm (1-inch) in diameter as specified in Section for plaster or gypsum board.

3.03 PAINT PREPARATION

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.04 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.

- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR.
- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not spray paint in existing occupied spaces unless approved by COR, except in spaces sealed from existing occupied spaces.
 - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
 - 2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- H. Do not paint in closed position operable items such as access doors and panels, window sashes, and similar items.

3.05 PRIME PAINTING

- A. After surface preparation prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.
- D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.
- E. Metals except boilers, incinerator stacks, and engine exhaust pipes:
 - 1. Steel and iron: MPI 95 (Fast Drying Metal Primer).
 - 2. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer).
- F. Gypsum Board:
 - 1. Surfaces scheduled to have MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), MPI 54 (Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE)) finish: Use MPI 50 (Interior Latex Primer Sealer).
 - 2. Primer: MPI 50 (Interior Latex Primer Sealer).

3.06 EXTERIOR FINISHES

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Steel and Ferrous Metal:
 - 1. Two coats of MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).

3.07 INTERIOR FINISHES

- A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Metal Work:
 - 1. Apply to exposed surfaces.
 - 2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
 - 3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
 - a. Apply two coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
- C. Gypsum Board:
 - 1. One coat of MPI 45 (Interior Primer Sealer) plus one coat of MPI 139 (Interior High Performance Latex, MPI Gloss level 3 (LL)).
- D. Miscellaneous:
 - 1. Apply where specified in Section 09 06 00, SCHEDULE FOR FINISHES.

3.08 REFINISHING EXISTING PAINTED SURFACES

- A. Clean, patch and repair existing surfaces as specified under surface preparation.
- B. Remove and reinstall items as specified under surface preparation.
- C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.
- D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
- E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
- F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one coat of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)).
- G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
- H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.
- I. Sand or dull glossy surfaces prior to painting.
- J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.09 PAINT COLOR

- A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.

- B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE.
- C. Coat Colors:
 - 1. Color of priming coat: Lighter than body coat.
 - 2. Color of body coat: Lighter than finish coat.
 - 3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- D. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
 - 1. Paint to match color of casework where casework has a paint finish.
 - 2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

3.10 BUILDING AND STRUCTURAL WORK FIELD PAINTING

- A. Painting and finishing of interior and exterior work except as specified under paragraph 3.10.B.
 - 1. Painting and finishing of new and existing work including colors and gloss of finish selected is specified in Finish Schedule, Section 09 06 00, SCHEDULE FOR FINISHES.
 - 2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
 - 3. Painting of ferrous metal and galvanized metal.
 - 4. Identity painting and safety painting.
- B. Building and Structural Work not Painted:
 - 1. Prefinished items:
 - a. Casework, doors, metal panels, wall covering, and similar items specified factory finished under other sections.
 - b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.
 - 2. Finished surfaces:
 - a. Hardware except ferrous metal.
 - b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
 - c. Signs, fixtures, and other similar items integrally finished.
 - 3. Concealed surfaces:
 - a. Inside interstitial spaces and above ceilings, except as otherwise specified.
 - b. Inside walls or other spaces behind access doors or panels.
 - c. Surfaces concealed behind permanently installed casework and equipment.
 - 4. Moving and operating parts: Mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
 - 5. Labels:
 - a. Code required label, such as Underwriters Laboratories Inc., Inchcape Testing Services, Inc., or Factory Mutual Research Corporation.
 - b. Identification plates, instruction plates, performance rating, and nomenclature.
 - 6. Galvanized metal:
 - a. Exterior chain link fence and gates and gratings.
 - b. Except where specifically specified to be painted.
 - 7. Gaskets.
 - 8. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.
 - 9. Structural steel encased in concrete or other enclosure.

10. Structural steel to receive sprayed-on fire proofing.
11. Ceilings, walls, columns in interstitial spaces.

3.11 PROTECTION CLEAN UP, AND TOUCH-UP

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

--- E N D ---

**SECTION 10 26 00
WALL PROTECTION**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies wall protection system including high impact wall protection covering, trims, and related accessories.

1.02 RELATED WORK

- A. Color and texture of resilient material: Section 09 06 00, SCHEDULE FOR FINISHES.

1.03 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Products shall be tested per ASTM E84 and shall be classified as Class A or I products with a flame spread rating of 25 or less and a smoke developed rating of 450 or less.
- B. Impact Strength: Assembled wall protection units that have been tested in accordance with applicable provisions of ASTM F476.
- C. Chemical and Stain resistance: Wall protection system components shall be tested in accordance with ASTM D-1308.
- D. Single Source Responsibility: All components of wall protection systems and related accessories shall be the products of a single manufacturer.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Show design, location, extent and installation details.
- C. Manufacturer's Literature and Data:
 - 1. Each component specified.
 - 2. Manufacturer's standard finishes for selection of colors.
- D. Samples: Sample of each product specified.
- E. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

1.05 DELIVERY AND STORAGE

- A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer.
- B. Protect from damage from handling and construction operations before, during and after installation.
- C. Store in a dry environment of approximately 21° C (70 degrees F) for at least 48 hours prior to installation.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A167-99(R2004)..... Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - B221-14..... Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
 - D256-10 Impact Resistance of Plastics
 - D635-10 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
 - E84-14..... Surface Burning Characteristics of Building Materials
- C. The National Association of Architectural Metal Manufacturers (NAAMM):
 - AMP 500 Series Metal Finishes Manual
- D. Society of American Automotive Engineers (SAE):
 - J 1545-14 Instrumental Color Difference Measurement for Exterior Finishes.
- E. Underwriters Laboratories Inc. (UL):
 - Annual Issue Building Materials Directory

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Wall Protection System:
 - 1. Vinyl/Acrylic Wall Covering: Nominal 0.040-inch (1.02mm) high impact vinyl/acrylic wall covering.
 - 2. Vinyl/Acrylic Trims:
 - a. Vertical Trims: 3/8-inch (10mm) thick x 2-inch (51 mm) wide x 8-feet (2.44m) long.
 - b. Horizontal (wainscot) Trim: 1/2-inch (13mm) thick x 2-inch (51 mm) wide x 8-feet (2.44m) long.
 - c. Inside/Outside Corner Trim: 3/8-inch (10mm) thick x 2-inch (51 mm) wide x 8-feet (2.44m) long.

2.02 FABRICATOIN

- A. Fabricate wall covering to comply with requirements indicated for design dimensions, detail, finish, and sizes.

2.03 ACCESSORIES

- A. Primer: Water based and non-hazardous as recommended by the manufacturer.
- B. Adhesive: Water based and non-hazardous as recommended by the manufacturer.

PART 3 - INSTALLATION

3.01 INSPECTION

- A. After finish painting of partitions and furring is complete, examine areas and conditions under which wall protection system are to be installed to verify surfaces are ready to receive Work of this Section.

3.02 PREPARATION

- A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris, and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
- B. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.03 INSTALLATION

- A. Install wall protection system in accordance with manufacturer's written instructions and as shown.
- B. Temperature at the time of installation must be between 65-75°F (18-24°C) and be maintained for at least 48 hours after the installation to allow for proper adhesive set up.
- C. Relative humidity shall not exceed 80%.
- D. Do not expose wall covering to direct sunlight during or after installation. This will cause the surface temperature to rise, which in turn will cause bubbles and delamination.

3.04 ADJUSTMENT AND CLEANING

- A. Prior to final acceptance, clean wall covering and accessories in accordance with manufacturer's recommended cleaning method.
- B. Remove and replace any defective, misaligned, or damaged units, at no additional expense to the Government.

--- E N D ---

**SECTION 12 32 00
MANUFACTURED WOOD CASEWORK**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies wood veneer casework as detailed on the drawings, including related components and accessories required to form integral units. Wood casework items shown on the drawings, but not specified below shall be included as part of the work under this section, and applicable portions of the specification shall apply to these items. Each like item of casework shall be of the same design and by one manufacturer.

1.02 RELATED WORK

- A. Sealants: Section 07 92 00, JOINT SEALANTS.
- B. Color of Casework Finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Backing Plates for Wall Mounted Casework: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

1.03 QUALITY ASSURANCE

- A. Single Source Responsibility: All custom casework, countertops, hardware, etc. specified under this Section shall be the product of one manufacturer and supplied under this manufacturer's direction to eliminate incompatible items.
- B. The Drawings and Specifications outline the design intent and the general requirements for custom casework for the project. Construction details and specifications for casework are not complete, and casework furnished shall be complete for the intended use.
- C. The Drawings and Specifications indicate requirements which may differ from manufacturer's standard product. Make all modifications necessary to comply with the requirements.
- D. Casework shall be designed, fabricated and installed to meet the quality standards established in the latest edition of the "Architectural Woodwork Standards" (AWS) Manual, as published by the Woodwork Institute (WI), Architectural Woodwork Institute (AWI), and the Architectural Woodwork Manufacturers Association of Canada (AWMAC).
 - 1. If provisions of the AWS Grade specified herein conflict with or are modified by the Drawings and/ or Specifications, the modifications shall govern.
- E. Manufacturer's Qualifications:
 - 1. Manufacturer of casework shall have an established organization and production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication and installation of the type of equipment specified, with skilled personnel, factory trained workmen and an experienced engineering department. Each shall have the demonstrated knowledge, ability and the proven capability to produce the specified equipment of the required quality and the proven capacity to complete the installation of this size and type within the required time limits.
 - 2. If the manufacturer of casework is not a WI licensee, the Contractor shall furnish to the Architect, prior to installation, a Certificate of Re-inspection by the WI indicating that the casework in question meets the requirements of the AWS

Grade specified. If the manufacturer of casework is a WI licensee, each unit of casework [except for stainless steel casework] shall bear the WI Certified Compliance Grade Stamp indicating the AWS Grade specified, and by the completion of the job, WI Certified Compliance Certificates shall have been issued certifying that the products furnished fully meet the requirements for the AWS Grade specified.

- a. The foregoing shall not be construed to limit the power and authority of the Architect to reject any casework which does not in the Architect's opinion meet with any one or more of the Specifications of this Contract.
- F. Field Measurements: Take field measurements prior to the preparation of shop drawings and fabrication where possible; do not delay job progress; allow for trimming and fitting where necessary.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 1. Hardware, including hinges, door pulls, locks, door catches, etc.
 2. Adhesive cements.
- C. Samples:
 1. Wood Face Veneer.
 2. Hardware, including hinges, door pulls, locks, door catches, etc.
- D. Shop Drawings (1/2 full size):
 1. All casework, showing plans, elevations, sections and details of construction, including materials, hardware and accessories.
 2. Fastenings and method of installation.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Do not deliver casework until all painting, wet work, grinding, finishing and overhead Work and similar operations which could damage, soil or deteriorate work have been completed.
- B. Protect casework during transit, delivery, storage and handling to prevent damage, soiling and deterioration. Keep covered with polyethylene film or other protective covering.
- C. Store casework in a dry location of the building, out of the way of other construction activities.
- D. Handle casework with care so as not to damage surfaces or subject the cases to stress.

1.06 PROJECT CONDITIONS

- A. Coordinate with plumbing, mechanical, and electrical Work and Government furnished equipment for proper sizing, location, and sequence of construction.
- B. All cutouts and holes for plumbing and electrical Work shall be made at the Project site.
- C. Conditioning: Maintain relative humidity planned for building occupants and an ambient

temperature between 65-degree F. and 75-degree F. in spaces to receive custom casework for at least seven (7) days before installation, during installation, and for at least seven (7) days after installation. After post-installation period, maintain relative humidity and ambient temperature planned for building occupants.

1.07 WARRANTY

- A. Construction Warranty: Comply with FAR clause 52.246-21 "Warranty of Construction".
- B. Manufacturer's Warranty: Manufacturer shall warranty their wood casework for a minimum of five (5) years from date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.08 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
A167-99 (R2009)..... Stainless and Heat-Resisting chromium-Nickel Steel Plate, Sheet and Strip
A1008/A1008M-13 Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy
- C. Composite Panel Association (CPA):
A208.2-09..... Medium Density Fiberboard
- D. U.S. Department of Commerce Product Standards (Prod. Std):
PS1-09 Construction and Industrial Plywood
- E. Hardwood, Plywood and Veneer Association (HPVA):
HP-1-09 Hardwood and Decorative Plywood
- F. Architectural Woodwork Institute (AWI):
Architectural Woodwork Quality Standards, Guide Specifications Quality Certification Program – 2009
- G. National Electrical Manufacturers Association (NEMA):
LD3-05 High Pressure Decorative Laminates
LD3.1-05 Performance, Application Fabrication and Installations of High-Pressure Decorative Laminates

PART 2 - PRODUCTS

2.01 PLYWOOD, HARDWOOD FACE VENEER

- A. HPVA HP-1, Premium Grade, plain sliced maple.

2.02 PLASTIC LAMINATE

- A. Standards: Comply with requirements of NEMA LD3.
- B. Items having plastic laminate finish. General purpose Type HGL.

- C. Cabinet Interiors Including Shelving: Both of following options to comply with NEMA, LD3.1 as a minimum.
 - 1. Plastic laminate clad plywood.
- D. Backing sheet on bottom of plastic laminate covered wood tops. Backer Type BKL.
- E. Post Forming Fabrication, Decorative Surface: Post forming Type HGP.

2.03 PLYWOOD, SOFTWOOD

- A. Prod. Std. PS1, five ply construction from 13 mm to 28 mm (1/2 inch to 1-1/8 inch) thickness, and seven ply for 31 mm (1 1/4 inch) thickness.
 - 1. Exterior Type, any species group.
 - 2. Veneer Grade: A-B or B-C.

2.04 MEDIUM DENSITY FIBERBOARD (MDF)

- A. Conforming to ANSI A208.2; 100% free of formaldehyde as a fabrication component, 48-pcf density.

2.05 STAINLESS STEEL

- A. ASTM A167, with No. 4 finish.

2.06 HARDWARE

- A. Where pin tumbler locks are specified, disc tumbler lock "Duo A", with brass working parts and case, as manufactured by the Illinois Lock Company will be an acceptable substitute. Locks for each type casework, shall be keyed differently and shall be master-keyed for each type service, such as Nurses, Psychiatric, and Administration. Provide two keys for each lock. Exposed hardware, except as otherwise specified, shall be satin finished chromium plated brass or nickel plated brass.
- B. Marking of Locks and Keys:
 - 1. The name of the manufacturer, or trademark by which manufacturer can readily be identified, legibly marked on each lock.
 - 2. The key change number marked on the exposed face of lock, and also stamped on each key.
 - 3. Key change numbers shall provide sufficient information for replacement of the key by the manufacturer.
- C. Hinged Doors:
 - 1. Hinges: Concealed adjustable hinges. Design to match specified numbers, self closing.
 - a. Provide 95-degree opening for cabinet door hinges adjacent to partition.
 - b. Provide 175-degree opening for all other cabinet doors hinges.
 - 2. Fasteners: Provide full thread wood screws to fasten hinge leaves to door and cabinet frame. Finish screws to match finish of hinges.
- D. Door Catches:
 - 1. Friction or Magnetic type, fabricated with metal housing.
 - 2. Provide one catch for cabinet doors 1200 mm (48 inches) high and under, and two for doors over 1200 mm (48 inches) high.
- E. Locks:

1. Cylinder type pin tumbler.
 2. Equip doors where shown with locks.
- F. Door Pulls: Stainless steel wire pull, 3 1/2-inch long, matte finish.
- G. Shelf Standards (Except For Fixed Shelves): Bright zinc-plated steel for recessed mounting with screws, 16 mm (5/8 inch) wide by 5 mm (3/16 inch) high providing 13 mm (1/2 inch) adjustment, complete with shelf supports.

2.07 FABRICATION

- A. General:
1. Fabricate casework in accordance with the specified AWS Grade standards, and as shown on Drawings and accepted Shop Drawings.
 2. All units shall have easily cleanable flush interiors.
 3. Shop-fabricate casework in whole units or in partial units as most practical for handling and transportation. Assemble partial units in place in such manner that each piece of casework becomes a unified whole visually and structurally. Fabricate fillers and scribe strips of same materials and finishes as cabinets with which they are associated.
 4. Fabricate all casework with plywood core and NO SUBSTITUTION, except otherwise specified. Use of particle board for casework shall be rejected.
 5. Make cuts required to accommodate the work of other Sections in the shop where possible. Review other drawings and work to determine extent of items to be mounted in casework. Notify Architect of discrepancies.
 6. Make cuts for hardware and equipment neat and true. Install hardware and fit securely.
 7. Adjust doors and movable shelves to operate easily and smoothly without binding.
- B. Wall Hung Cabinets:
1. All cabinets shall be Style A (frameless), consisting of multiple self-supporting units fastened together to form a larger unit, in accordance with AWS Standards, Premium Grade, unless otherwise shown.
 - a. All exposed and semi-exposed surfaces shall have wood veneer finish, unless otherwise shown on Drawings and specified herein.
 - b. Exposed Interior Surfaces: Interior faces of cabinet doors shall match exposed faces.
 2. Doors:
 - a. Solid Swinging Doors: AWS Cabinet Door Type "A." 3/4-inch thick, hardwood plywood with wood veneer edge banding on all four (4) sides. Use of PVC edge banding will not be acceptable.
 - i. Edge Banding shall be the same pattern and color as the exposed face of the door.
 - ii. Interior face of door shall be faced with the same pattern and color as the exposed face.
 - iii. Each door shall close against two rubber bumpers.
 - b. Hinges: As per manufacturer's recommendation, minimum two (2) hinges for doors under 40-inch in height; three (3) hinges for doors 40-inch to 60-inch in height; four (4) hinges for full height doors.
 - c. Door Latches: As per manufacturer's recommendation, minimum one (1) latch per door.
 3. Adjustable Shelves: Plastic laminate finish over 1-inch thick plywood core. Apply plastic laminate to all surfaces.
 - a. Screw all shelves to shelf supports. Locations of adjustable shelves to

- be directed by Contracting Officer's Representative (COR).
4. Keying: Provide two keys for each lock.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Make all field measurements, and verify all dimensions prior to installation. Accurately fit all casework and components.
- B. Verify that surfaces and spaces to receive casework are satisfactory for installation. If unsatisfactory conditions exist, do not commence installation until such conditions have been corrected.
- C. Prior to installation of casework, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.02 INSTALLATION

- A. Install casework under direct supervision of the casework manufacturer.
- B. Install casework straight, plumb, level and true with no distortions. Shim as required using concealed shims. Where casework abuts other finished work, scribe and apply filler strips for accurate fit with all fasteners concealed where practicable.
- C. Secure all wall hung cabinets to backing plates as shown and scheduled. Anchor, adjust, and align wall hung cabinets as specified.
- D. Provide fillers and scribe strips so that cabinet fronts, and sides present finished and unbroken surface to adjacent cabinet units or partitions. Cut scribe strips so that no gap greater than 1/16-inch exists where casework is fitted against flat or irregular surfaces.
- E. Sealant Application:
 1. Casework installer supervisor shall field check each sealant application for total seal.

3.03 ADJUSTMENT, CLEANING, AND PROTECTION

- A. Following completion of installation, clean surfaces of casework, and clean and polish hardware, in conformance with manufacturer's recommendations.
- B. Repair damaged and defective casework where possible to eliminate defects; where not possible to properly repair, replace.
- C. Clean, lubricate and make final adjustments to hardware for proper operation.
- D. Clean casework on exposed and semi-exposed surfaces. Touch-up shop-applied finishes to restore damaged or soiled areas.
- E. Protect casework to ensure work will be without damage at time of Substantial Completion. Cover completed casework with 4-mil polyethylene film protective enclosure, applied in a manner to permit easy removal.

--- E N D ---

SECTION 13 05 41
SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Provide seismic restraint in accordance with the requirements of this section in order to maintain the integrity of nonstructural components of the building so that they remain safe and functional in case of seismic event.
- B. The design to resist seismic load shall be based on Seismic Design Categories per section 4.0 of the VA Seismic Design Requirements (H-18-8) dated August 2013, <http://www.cfm.va.gov/til/etc/seismic.pdf>.
- C. Definitions: Non-structural building components are components or systems that are not part of the building's structural system whether inside or outside, above or below grade. Non-structural components of buildings include:
 - 1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; medical equipment; and storage racks.
 - 2. Electrical Elements: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; special life support systems; and telephone and communication systems.
 - 3. Mechanical Elements: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler equipment and components.
 - 4. Transportation Elements: Mechanical, electrical and structural elements for transport systems, i.e., elevators and dumbwaiters, including hoisting equipment and counterweights.

1.2 QUALITY CONTROL:

- A. Shop-Drawing Preparation:
 - 1. Have seismic-force-restraint shop drawings and calculations prepared by a professional structural engineer experienced in the area of seismic force restraints. The professional structural engineer shall be registered in the state where the project is located.

2. Submit design tables and information used for the design-force levels, stamped and signed by a professional structural engineer registered in the State where project is located.

B. Coordination:

1. Do not install seismic restraints until seismic restraint submittals are approved by the Resident Engineer.
2. Coordinate and install trapezes or other multi-pipe hanger systems prior to pipe installation.

C. Seismic Certification:

In structures assigned to IBC Seismic Design Category C, D, E, or F, permanent equipments and components are to have Special Seismic Certification in accordance with requirements of section 13.2.2 of ASCE 7 except for equipment that are considered rugged as listed in section 2.2 OSHPD code application notice CAN No. 2-1708A.5, and shall comply with section 13.2.6 of ASCE 7.

1.3 SUBMITTALS:

A. Submit a coordinated set of equipment anchorage drawings prior to installation including:

1. Description, layout, and location of items to be anchored or braced with anchorage or brace points noted and dimensioned.
2. Details of anchorage or bracing at large scale with all members, parts brackets shown, together with all connections, bolts, welds etc. clearly identified and specified.
3. Numerical value of design seismic brace loads.
4. For expansion bolts, include design load and capacity if different from those specified.

B. Submit prior to installation, a coordinated set of bracing drawings for seismic protection of piping, with data identifying the various support-to-structure connections and seismic bracing structural connections, include:

1. Single-line piping diagrams on a floor-by-floor basis. Show all suspended piping for a given floor on the same plain.
2. Type of pipe (Copper, steel, cast iron, insulated, non-insulated, etc.).
3. Pipe contents.
4. Structural framing.
5. Location of all gravity load pipe supports and spacing requirements.
6. Numerical value of gravity load reactions.
7. Location of all seismic bracing.
8. Numerical value of applied seismic brace loads.

9. Type of connection (Vertical support, vertical support with seismic brace etc.).
 10. Seismic brace reaction type (tension or compression): Details illustrating all support and bracing components, methods of connections, and specific anchors to be used.
- C. Submit prior to installation, bracing drawings for seismic protection of suspended ductwork and suspended electrical and communication cables, include:
1. Details illustrating all support and bracing components, methods of connection, and specific anchors to be used.
 2. Numerical value of applied gravity and seismic loads and seismic loads acting on support and bracing components.
 3. Maximum spacing of hangers and bracing.
 4. Seal of registered structural engineer responsible for design.
- D. Submit design calculations prepared and sealed by the registered structural engineer specified above in paragraph 1.3A.
- E. Submit for concrete anchors, the appropriate ICBC evaluation reports, OSHPD pre-approvals, or lab test reports verifying compliance with OSHPD Interpretation of Regulations 28-6.

1.4 APPLICABLE PUBLICATIONS:

- A. The Publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
355.2-07.....Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary
- C. American Institute of Steel Construction (AISC):
Load and Resistance Factor Design, Volume 1, Second Edition
- D. American Society for Testing and Materials (ASTM):
A36/A36M-08.....Standard Specification for Carbon Structural Steel
A53/A53M-10.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A307-10.....Standard Specification for Carbon Steel Bolts and Studs; 60,000 PSI Tensile Strength.
A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

- A325M-09.....Standard Specification for High-Strength Bolts
for Structural Steel Joints [Metric]
- A490-10.....Standard Specification for Heat-Treated Steel
Structural Bolts, 150 ksi Minimum Tensile
Strength
- A490M-10.....Standard Specification for High-Strength Steel
Bolts, Classes 10.9 and 10.9.3, for Structural
Steel Joints [Metric]
- A500/A500M-10.....Standard Specification for Cold-Formed Welded
and Seamless Carbon Steel Structural Tubing in
Rounds and Shapes
- A501-07.....Specification for Hot-Formed Welded and Seamless
Carbon Steel Structural Tubing
- A615/A615M-09.....Standard Specification for Deformed and Plain
Billet-Steel Bars for Concrete Reinforcement
- A992/A992M-06.....Standard Specification for Steel for Structural
Shapes for Use in Building Framing
- A996/A996M-09.....Standard Specification for Rail-Steel and Axel-
Steel Deformed Bars for Concrete
Reinforcement
- E488-96(R2003).....Standard Test Method for Strength of Anchors in
Concrete and Masonry Element
- E. American Society of Civil Engineers (ASCE 7) Latest Edition.
- F. International Building Code (IBC) Latest Edition
- G. VA Seismic Design Requirements, H-18-8, August 2013
- H. National Uniform Seismic Installation Guidelines (NUSIG)
- I. Sheet Metal and Air Conditioning Contractors National Association
(SMACNA): Seismic Restraint Manual - Guidelines for Mechanical Systems,
1998 Edition and Addendum

1.5 REGULATORY REQUIREMENT:

- A. IBC Latest Edition.
- B. Exceptions: The seismic restraint of the following items may be omitted:
 - 1. Equipment weighing less than 400 pounds, which is supported directly
on the floor or roof.
 - 2. Equipment weighing less than 20 pounds, which is suspended from the
roof or floor or hung from a wall.
 - 3. Gas and medical piping less than 2 ½ inches inside diameter.
 - 4. Piping in boiler plants and equipment rooms less than 1 ¼ inches
inside diameter.

5. All other piping less than 2 ½ inches inside diameter, except for automatic fire suppression systems.
6. All piping suspended by individual hangers, 12 inches or less in length from the top of pipe to the bottom of the support for the hanger.
7. All electrical conduits, less than 2 ½ inches inside diameter.
8. All rectangular air handling ducts less than six square feet in cross sectional area.
9. All round air handling ducts less than 28 inches in diameter.
10. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of support for the hanger.

PART 2 - PRODUCTS

2.1 STEEL:

- A. Structural Steel: ASTM A36
- B. Structural Tubing: ASTM A500, Grade B.
- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53/A53M, Grade B.
- E. Bolts & Nuts: ASTM A325

2.2 CAST-IN-PLACE CONCRETE:

- A. Concrete: 28 day strength, f'c = 30 MPa (4,000 psi)
- B. Reinforcing Steel: ASTM A615/615M or ASTM A996/A996M deformed.

PART 3 - EXECUTION

3.1 CONSTRUCTION, GENERAL:

- A. Provide equipment supports and anchoring devices to withstand the seismic design forces, so that when seismic design forces are applied, the equipment cannot displace, overturn, or become inoperable.
- B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.
- C. Construct seismic restraints and anchorage to allow for thermal expansion.
- D. Testing Before Final Inspection:
 1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.
 2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

3.2 EQUIPMENT RESTRAINT AND BRACING:

- A. See drawings for equipment to be restrained or braced.

**3.3 MECHANICAL DUCTWORK AND PIPING; BOILER PLANT STACKS AND BREACHING;
ELECTRICAL BUSWAYS, CONDUITS, AND CABLE TRAYS; AND TELECOMMUNICATION WIRES AND
CABLE TRAYS**

- A. Support and brace mechanical ductwork and piping; electrical busways, conduits and cable trays; and telecommunication wires and cable trays including boiler plant stacks and breeching to resist directional forces (lateral, longitudinal and vertical).
- B. Brace duct and breeching branches with a minimum of 1 brace per branch.
- D. Provide supports and anchoring so that, upon application of seismic forces, piping remains fully connected as operable systems which will not displace sufficiently to damage adjacent or connecting equipment, or building members.
- E. Seismic Restraint of Piping:
1. Design criteria: Design bracing in accordance with IBC, ASCE-7 and VA H-18-8.
- F. Piping Connections: Provide flexible connections where pipes connect to equipment. Make the connections capable of accommodating relative differential movements between the pipe and equipment under conditions of earthquake shaking.

3.4 PARTITIONS

- A. In buildings with flexible structural frames, anchor partitions to only structural element, such as a floor slab, and separate such partition by a physical gap from all other structural elements.

3.5 CEILINGS AND LIGHTING FIXTURES

- A. At regular intervals, laterally brace suspended ceilings against lateral and vertical movements, and provide with a physical separation at the walls.
- B. Independently support and laterally brace all lighting fixtures. Refer to applicable portion of lighting specification, Section 26 51 00, INTERIOR LIGHTING.

3.6 FACADES AND GLAZING

- A. Do not install concrete masonry unit filler walls in a manner that can restrain the lateral deflection of the building frame. Provide a gap with adequately sized resilient filler to separate the structural frame from the non-structural filler wall.
- B. Install attachments to structure for all façade materials as shown on construction drawings to ensure strength against applicable seismic forces at the project location.

3.7 STORAGE RACKS, CABINETS, AND BOOKCASES

- A. Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.
- B. Anchor medical supply cabinets to the floor or walls and equip them with properly engaged, lockable latches.
- C. Anchor filing cabinets that are more than 2 drawers high to the floor or walls, and equip all drawers with properly engaged, lockable latches.
- D. Anchor bookcases that are more than 30 inches high to the floor or walls, and equip any doors with properly engaged, lockable latches.

- - - E N D - - -

**SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.02 MINIMUM REQUIREMENTS

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.03 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with

evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.04 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
 1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
 2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.05 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.06 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the COR a minimum of 15 working days prior to the manufacturer's performing the factory tests.
 - 2. Four copies of certified test reports shall be furnished to the COR two weeks prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

1.07 VARIATIONS FROM CONTRACT REQUIREMENTS

- A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.08 MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
 - 1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
 - 2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
 - 3. Damaged equipment shall be repaired or replaced, as determined by the COR.
 - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - 5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.09 WORK PERFORMANCE

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 - 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 - 2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the COR and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
 - 3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COR.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article

OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm²), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

- A. Submit to the COR in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.
- E. The submittals shall include the following:
 - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
 - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.

3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
- F. Maintenance and Operation Manuals:
1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
 3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 4. The manuals shall include:
 - a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the COR with one sample of each of the following:
 - 1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 - 2. Each type of conduit coupling, bushing, and termination fitting.
 - 3. Conduit hangers, clamps, and supports.
 - 4. Duct sealing compound.
 - 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 POLYCHLORINATED BIPHENYL (PCB) EQUIPMENT

- A. This project requires the removal, transport, and disposal of electrical equipment containing Polychlorinated Biphenyls (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).
- B. The equipment to be removed is shown on the drawings.
- C. The selective demolition shall be in accordance with Section 02 41 00, DEMOLITION.

1.15 ACCEPTANCE CHECKS AND TESTS

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.16 WARRANTY

- A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.17 INSTRUCTION

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the COR at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END OF SECTION---

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.02 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:
Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.
- D. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

1.03 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.04 FACTORY TESTS

- A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.05 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit the following data for approval:
 - 1) Electrical ratings and insulation type for each conductor and cable.
 - 2) Splicing materials and pulling lubricant.
 - 2. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):
 - D2301-10 Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
 - D2304-10 Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
 - D3005-10 Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
 - WC 70-09 Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
 - 70-11 National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
 - 44-10 Thermoset-Insulated Wires and Cables
 - 83-08 Thermoplastic-Insulated Wires and Cables
 - 467-07 Grounding and Bonding Equipment
 - 486A-486B-03 Wire Connectors
 - 486C-04 Splicing Wire Connectors
 - 486D-05 Sealed Wire Connector Systems
 - 486E-09 Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
 - 493-07 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
 - 514B-04 Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.

- B. All conductors shall be copper.
- C. Single Conductor and Cable:
 - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
 - 2. No. 8 AWG and larger: Stranded.
 - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
 - 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

D. Direct Burial Cable: UF or USE cable.

- E. Color Code:
 - 1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 - 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
 - 4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 - 5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

- 6. Lighting circuit “switch legs”, and 3-way and 4-way switch “traveling wires,” shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the COR.
- 7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.02 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
 4. All bolts, nuts, and washers used with splices shall be zinc-plated steel.
- D. Above Ground Splices for 250 kcmil and Larger:
1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.
- E. Underground Splices for No. 10 AWG and Smaller:
1. Solderless, screw-on, reusable pressure cable type, with integral insulation. Listed for wet locations, and approved for copper and aluminum conductors.
 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- F. Underground Splices for No. 8 AWG and Larger:
1. Mechanical type, of high conductivity and corrosion-resistant material. Listed for wet locations, and approved for copper and aluminum conductors.
 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 3. Splice and insulation shall be product of the same manufacturer.

- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.03 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

2.04 CONTROL WIRING

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.05 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 - 2. Use nonmetallic pull ropes.
 - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. All conductors in a single conduit shall be pulled simultaneously.
 - 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.02 INSTALLATION IN MANHOLES

- A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.
- B. Fireproofing:
 - 1. Install fireproofing on low-voltage conductors where the low-voltage conductors are installed in the same manholes with medium-voltage conductors.
 - 2. Use fireproofing tape as specified in Section 26 05 13, MEDIUM-VOLTAGE CABLES, and apply the tape in a single layer, half-lapped, or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (1 inch) into each duct.
 - 3. Secure the fireproofing tape in place by a random wrap of glass cloth tape.

3.03 SPLICE AND TERMINATION INSTALLATION

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.04 CONDUCTOR IDENTIFICATION

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.05 FEEDER CONDUCTOR IDENTIFICATION

- A. In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.06 EXISTING CONDUCTORS

- A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.07 CONTROL WIRING INSTALLATION

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.08 CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.
- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.09 DIRECT BURIAL CABLE INSTALLATION

- A. Tops of the cables:
 - 1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
 - 2. Below road and other pavement surfaces: In conduit as specified, minimum 760 mm (30 inches) unless greater depth is shown.
 - 3. Do not install cables under railroad tracks.
- B. Under road and paved surfaces: Install cables in concrete-encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare.
- C. Work with extreme care near existing ducts, conduits, cables, and other utilities to prevent any damage.
- D. Excavation and backfill is specified in Section 31 20 00, EARTH MOVING. In addition:
 - 1. Place 75 mm (3 inches) bedding sand in the trenches before installing the cables.
 - 2. Place 75 mm (3 inches) shading sand over the installed cables.

3. Install continuous horizontal 25 mm by 200 mm (1 inch x 8 inches) preservative-impregnated wood planking 75 mm (3 inches) above the cables before backfilling.
- E. Provide horizontal slack in the cables for contraction during cold weather.
- F. Install the cables in continuous lengths. Splices within cable runs shall not be accepted.
- G. Connections and terminations shall be listed submersible-type designed for the cables being installed.
- H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.

3.10 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 1. Visual Inspection and Tests: Inspect physical condition.
 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

---END OF SECTION---

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.02 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

1.03 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.04 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports:
 - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the COR.
 - 3. Certifications:
 - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.05 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
 - B1-07 Standard Specification for Hard-Drawn Copper Wire
 - B3-07 Standard Specification for Soft or Annealed Copper Wire
 - B8-11 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-83 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
 - 70-11 National Electrical Code (NEC)
 - 70E-12 National Electrical Safety Code
 - 99-12 Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
 - 44-10 Thermoset-Insulated Wires and Cables
 - 83-08 Thermoplastic-Insulated Wires and Cables
 - 467-07 Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.01 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.
- D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.02 GROUND RODS

- A. copper clad steel 19 mm (0.75 inch) diameter by 3 M (10 feet) long.

- B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.03 CONCRETE ENCASED ELECTRODE

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.04 GROUND CONNECTIONS

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
- B. System Grounding:
 - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- D. For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

3.02 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.03 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

- A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.
- B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding

provisions of medium-voltage cable splices and terminations, and to equipment enclosures.

- C. Pad-Mounted Transformers:
 - 1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
 - 2. Ground the secondary neutral.
- D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

3.04 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
 - 2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.

3.05 RACEWAY

- A. Conduit Systems:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
 - 3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
 - 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
 2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
 3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
 4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- H. Raised Floors: Provide bonding for all raised floor components as shown on the drawings.
- I. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.06 CORROSION INHIBITORS

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.07 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.08 EXTERIOR LIGHT POLES

- A. Provide 6.1 M (20 feet) of No. 4 AWG bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

3.09 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.10 GROUND ROD INSTALLATION

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
- B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
- C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.11 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

---END OF SECTION---

**SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.02 RELATED WORK

- A. Mounting board for telephone closets: Section 06 10 00, ROUGH CARPENTRY.
- B. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- C. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- D. General electrical requirements and items that is common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- E. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

1.03 SUBMITTALS

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

- A. Shop Drawings:
 - 1. Size and location of pull boxes
 - 2. Layout of required conduit penetrations through structural elements.
 - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- B. Certification: Prior to final inspection, deliver to the COR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

1.04 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):
 - 70-05 National Electrical Code (NEC)

- C. Underwriters Laboratories, Inc. (UL):
 - 6-03 Rigid Metal Conduit
 - 50-03 Enclosures for Electrical Equipment
 - 360-03 Liquid-Tight Flexible Steel Conduit
 - 467-01 Grounding and Bonding Equipment
 - 514A-01 Metallic Outlet Boxes
 - 514B-02 Fittings for Cable and Conduit
 - 797-03 Electrical Metallic Tubing
 - 1242-00 Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
 - TC-3-04 PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - FB1-03 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit,
Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 19 mm (3/4 inch) unless otherwise shown. Where permitted by the NEC, 19 mm (3/4 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
 - 1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
 - 2. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
 - 3. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3.
Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
 - 4. Flexible galvanized steel conduit: Shall Conform to UL 1.
 - 5. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
- C. Conduit Fittings:
 - 1. Rigid steel and IMC conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
 - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.

- d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
 - e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - f. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
3. Electrical metallic tubing fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - d. Indent type connectors or couplings are prohibited.
 - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible steel conduit fittings:
- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp type, with insulated throat.
5. Liquid-tight flexible metal conduit fittings:
- a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
6. Direct burial plastic conduit fittings:
- a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 - b. As recommended by the conduit manufacturer.

7. Surface metal raceway fittings: As recommended by the raceway manufacturer.
8. Expansion and deflection couplings:
 - a. Conform to UL 467 and UL 514B.
 - b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
 - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
- E. Outlet, Junction, and Pull Boxes:
 1. UL-50 and UL-514A.
 2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
 4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRIC LINE BELOW".

PART 3 - EXECUTION

3.01 PENETRATIONS

- A. Cutting or Holes:
 1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the COR prior to drilling through structural sections.
- B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an

effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS.

3.02 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, as shown, and as hereinafter specified.
- B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where specifically "accepted" by NEC Article 517.
- C. Install conduit as follows:
1. In complete runs before pulling in cables or wires.
 2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
 3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
 4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
 5. Mechanically and electrically continuous.
 6. Independently support conduit at 8'0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
 7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
 8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
 9. Conduit installations under fume and vent hoods are prohibited.
 10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
 11. Do not use aluminum conduits in wet locations.
 12. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.

3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

3.03 CONCEALED WORK INSTALLATION

- A. Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
 2. Conduit for conductors 600 volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
 3. Align and run conduit parallel or perpendicular to the building lines.
 4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
 5. Tightening set screws with pliers is prohibited.

3.04 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for conductors above 600 volts:
1. Rigid steel or rigid aluminum.
 2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
- C. Conduit for Conductors 600 volts and below:
1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- G. Surface metal raceways: Use only where shown.
- H. Painting:
1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.

2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

3.05 DIRECT BURIAL INSTALLATION

- A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1500 mm (5 feet) from the buildings):
 1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
 2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
 3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
 4. Tops of conduits shall be as follows unless otherwise shown:
 - a. Not less than 600 mm (24 inches) below finished grade.
 - b. Not less than 750 mm (30 inches) below road and other paved surfaces.
 5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
 6. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
 7. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with .5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
 8. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.

3.06 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
- B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.07 WET OR DAMP LOCATIONS

- A. Unless otherwise shown, use conduits of rigid steel or IMC.

- B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.
- C. Unless otherwise shown, use rigid steel or IMC conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.08 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.09 EXPANSION JOINTS

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.//

3.10 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the

- conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
 - E. Bolts supported only by plaster or gypsum wallboard are not acceptable.
 - F. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
 - G. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
 - H. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
 - I. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
 - J. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
 - 1. Flush mounted.
 - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.

--- END OF SECTION---

**SECTION 26 05 41
UNDERGROUND ELECTRICAL CONSTRUCTION**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of precast manholes and pullboxes with ducts to form a complete underground raceway system.
- B. "Duct" and "conduit," and "rigid metal conduit" and "rigid steel conduit" are used interchangeably in this specification.

1.02 RELATED WORK

- A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings and boxes for raceway systems.

1.03 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Coordinate layout and installation of ducts, manholes, pullboxes, and pull-boxes with final arrangement of other utilities, site grading, and surface features, as determined in the field.

1.04 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
 - 2. Include manholes, pullboxes, duct materials, and hardware. Submit plan and elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories and details.
 - 3. Proposed deviations from details on the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes or pullboxes at locations other than shown on the drawings, show the proposed locations accurately on scaled

site drawings, and submit four copies to the CONTRACTING OFFICER'S REPRESENTATIVE for approval prior to construction.

- C. Certifications: Two weeks prior to the final inspection, submit four copies of the following certifications to the CONTRACTING OFFICER'S REPRESENTATIVE:
 - 1. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
 - 2. Certification by the contractor that the materials have been properly installed, connected, and tested.

1.05 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Concrete Institute (ACI):
 - Building Code Requirements for Structural Concrete
 - 318/318M-05 Building Code Requirements for Structural Concrete & Commentary
 - SP-66-04 ACI Detailing Manual
- C. American National Standards Institute (ANSI):
 - 77-07 Underground Enclosure Integrity
- D. American Society for Testing and Materials (ASTM):
 - C478-09 Standard Specification for Precast Reinforced Concrete Manhole Sections
 - C858-09 Underground Precast Concrete Utility Structures
 - C990-09 Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.
- E. Institute of Electrical and Electronic Engineers (IEEE):
 - C2-07 National Electrical Safety Code
- F. National Electrical Manufacturers Association (NEMA):
 - TC 2-03 Electrical Polyvinyl Chloride (PVC) Tubing And Conduit
 - TC 3-2004 PVC Fittings for Use With Rigid PVC Conduit And Tubing
 - TC 6 & 8 2003 PVC Plastic Utilities Duct For Underground Installations
 - TC 9-2004 Fittings For PVC Plastic Utilities Duct For Underground Installation
- G. National Fire Protection Association (NFPA):
 - 70-08 National Electrical Code (NEC)
- H. Underwriters Laboratories, Inc. (UL):

- 6-07 Electrical Rigid Metal Conduit-Steel
- 467-07 Grounding and Bonding Equipment
- 651-05 Schedule 40 and 80 Rigid PVC Conduit and Fittings
- 651A-00 Type EB and A Rigid PVC Conduit and HDPE Conduit
- 651B-07 Continuous Length HDPE Conduit

- I. U.S. General Services Administration (GSA):
 - A-A-60005-1998 Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

1.06 STORAGE

Lift and support pre-cast concrete structures only at designated lifting or supporting points.

PART 2 - PRODUCTS

2.01 PRE-CAST CONCRETE MANHOLES AND HARDWARE

- A. Structure: Factory-fabricated, reinforced-concrete, monolithically-poured walls and bottom. Frame and cover shall form top of manhole. Comply with ASTM C 858.
- B. Cable Supports:
 - 1. Cable stanchions shall be hot-rolled, heavy duty, hot-dipped galvanized "T" section steel, 2.25 in [56 mm] x 0.25 in [6 mm] in size, and punched with 14 holes on 1.5 in [38 mm] centers for attaching cable arms.
 - 2. Cable arms shall be 0.1875 in [5 mm] gauge, hot-rolled, hot-dipped galvanized sheet steel, pressed to channel shape. Arms shall be approximately 2.5 in [63 mm] wide x 14 in [350 mm] long.
 - 3. Insulators for cable supports shall be high-glazed, wet process porcelain, and shall completely encircle the cable.
 - 4. Equip each cable stanchion with two spare cable arms and six spare insulators for future use.
- C. Ground Rod Sleeve: Provide a 3 in [75 mm] PVC sleeve in manhole floors so that a driven ground rod may be installed.

2.02 PULLBOXES

- A. General: Size as indicated on drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or SIGNAL as applicable. Pullboxes shall comply with the requirements of ANSI/SCTE 77 loading. Provide pulling irons, 0.875 in [22 mm] diameter galvanized steel bar with exposed triangular-shaped opening.
- B. Concrete Pullboxes: Shall be monolithically-poured reinforced concrete.

2.03 DUCTS

- A. Number and sizes shall be as shown on drawings.
- B. Ducts (concrete-encased):
 - 1. Plastic Duct:
 - a. UL 651 and 651A Schedule 40 PVC.
 - b. Duct shall be suitable for use with 194° F [90° C] rated conductors.
 - 2. Conduit Spacers: Prefabricated plastic.
- C. Ducts (direct-burial):
 - 1. Plastic duct:
 - a. NEMA TC2 and TC3
 - b. UL 651, 651A, and 651B, Schedule 40 PVC or HDPE.
 - c. Duct shall be suitable for use with 167° F [75° C] rated conductors.
 - 2. Rigid metal conduit: UL6 and NEMA RN1 galvanized rigid steel, threaded type, half-lapped with 10 mil PVC tape.

2.04 GROUNDING

- A. Rods: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. Ground Wire: Stranded bare copper 6 AWG [16 mm²] minimum.

2.05 WARNING TAPE

Standard 4-mil polyethylene 3 in [76 mm] wide detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

2.06 PULL ROPE FOR SPARE DUCTS

Plastic with 200 lb [890 N] minimum tensile strength.

PART 3 - EXECUTION

3.01 MANHOLE AND PULLBOX INSTALLATION

- A. Assembly and installation shall follow the printed instructions and recommendations of the manufacturer. Install manholes and pullboxes level and plumb.
 - 1. Units shall be installed on a 12 in [300 mm] level bed of 90% compacted granular fill, well-graded from the 1 in [25 mm] sieve to the No. 4 sieve. Granular fill shall be compacted with a minimum of four passes with a plate compactor.
 - 2. Seal duct terminations so they are watertight.
- B. Access: Ensure the top of frames and covers are flush with finished grade.
- C. Ground Rods in Manholes: Drive a ground rod into the earth, through the floor sleeve, after the manhole is set in place. Fill the sleeve with sealant to make a watertight seal. Rods shall protrude approximately 4 in [100 mm] above the manhole floor.
- D. Grounding in Manholes:

1. Install a No. 3/0 AWG [95 mm²] bare copper ring grounding conductor around the inside perimeter of the manhole and anchor to the walls with metallic cable clips.
2. Connect the ring grounding conductor to the ground rod by an exothermic welding process.
3. Bond the ring grounding conductor to the duct bank equipment grounding conductors, the exposed non-current carrying metal parts of racks, sump covers, and like items in the manholes with a minimum No. 6 AWG [16 mm²] bare copper jumper.

3.02 TRENCHING

- A. Refer to EARTH MOVING for trenching, backfilling, and compaction.
- B. Before performing trenching work at existing facilities, the Ground Penetrating Radar Survey shall be carefully performed by certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.
- C. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
- D. Cut the trenches neatly and uniformly.
- E. For Concrete-Encased Ducts:
 1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 4 ft [1.2 M] intervals to establish the grade and route of the duct bank.
 2. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward buildings wherever possible.
 3. The walls of the trench may be used to form the side walls of the duct bank, provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
 4. After the concrete-encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, and appropriate warning tape installed.
- F. Conduits to be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place. Conduits shall be heavy wall rigid steel.

3.03 DUCT INSTALLATION

- A. General Requirements:
 1. Ducts shall be in accordance with the NEC and IEEE C2, as shown on the drawings, and as specified.

2. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 4 in [100 mm] in 100 ft [30 M].
3. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be taped galvanized rigid steel, and shall extend a minimum of 5 ft [1.5 M] outside the building foundation. Tops of conduits below building slab shall be minimum 24 in [610 mm] below bottom of slab.
4. Stub-ups, sweeps, and risers to equipment mounted on outdoor concrete slabs shall be taped galvanized rigid steel, and shall extend a minimum of 5 ft [1.5 M] away from the edge of slab.
5. Install insulated grounding bushings on the terminations.
6. Radius for turns of direction shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times conduit diameter. Use manufactured long sweep bends.
7. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 3 in [75 mm] above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 5 ft [1.5 M]. Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 12 in [300 mm] from other utility systems, such as water, sewer, and chilled water.
10. Clearances between individual ducts:
 - a. For like services, not less than 3 in [75 mm].
 - b. For power and signal services, not less than 6 in [150 mm].
11. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.
12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
14. Seal conduits, including spare conduits, at building entrances and at outdoor equipment terminations with a suitable compound to prevent entrance of moisture and gases.

- B. and Direct-Burial Duct and Conduit Identification: Place continuous strip of warning tape approximately 12 in [300 mm] above ducts or conduits before backfilling trenches. Warning tape shall be preprinted with proper identification.
- C. Spare Ducts and Conduits: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
- D. Duct and Conduit Cleaning:
 - 1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct. The mandrel shall be not less than 12 in [3600 mm] long, and shall have a diameter not less than 0.5 in [13 mm] less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
 - 2. Mandrel pulls shall be witnessed by the CONTRACTING OFFICER'S REPRESENTATIVE.
- E. Duct and Conduit Sealing: Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.
- F. Connections to Manholes: Ducts connecting to manholes shall be flared to have an enlarged cross-section to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 in [300 mm] in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct and the wall of the manhole. Use vibrators when this portion of the encasement is poured to ensure a seal between the envelope and the wall of the structure.
- G. Connections to Existing Manholes: For duct connections to existing manholes, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.
- H. Connections to Existing Ducts: Where connections to existing duct banks are indicated, excavate around the duct banks as necessary. Cut off the ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with the new ducts, to take the shear at the joint of the duct banks.

- I. Partially-Completed Duct Banks: During construction, wherever a construction joint is necessary in a duct bank, prevent debris such as mud and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 ft [0.6 M] back into the envelope and a minimum of 2 ft [0.6 M] beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 in [75 mm] from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 12 in [300 mm] apart. Restrain reinforcing assembly from moving during pouring of concrete.

--- END OF SECTION ---

**SECTION 26 09 23
LIGHTING CONTROLS**

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the furnishing, installation and connection of the lighting controls.

1.02 RELATED WORK

- A. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Interface of lighting controls with HVAC control systems.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- E. Section 24 26 16, PANELBOARDS: panelboard enclosure and interior bussing used for lighting control panels.
- F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.03 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.04 SUBMITTALS

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Product Data: For each type of lighting control, submit the following information.
 - 1. Manufacturer's catalog data.
 - 2. Wiring schematic and connection diagram.
 - 3. Installation details.
- C. Manuals:
 - 1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.
 - 2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the COR.
- D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COR:
 - a. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.

1.05 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):
GC-12..... Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):
IESNA LM-48 Guide for Calibration of Photoelectric Control Devices
- D. National Electrical Manufacturer's Association (NEMA)
C136.10..... American National Standard for Roadway Lighting Equipment-
Locking-Type Photocontrol Devices and Mating Receptacles -
Physical and Electrical Interchangeability and Testing
ICS-1 Standard for Industrial Control and Systems General Requirements
ICS-2..... Standard for Industrial Control and Systems: Controllers,
Contractors, and Overload Relays Rated Not More than 2000
Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in
Industrial Control Equipment
ICS-6 Standard for Industrial Controls and Systems Enclosures
- E. Underwriters Laboratories, Inc. (UL):
20 Standard for General-Use Snap Switches
773 Standard for Plug-In Locking Type Photocontrols for Use with
Area Lighting
773A Nonindustrial Photoelectric Switches for Lighting Control
98 Enclosed and Dead-Front Switches
917..... Clock Operated Switches

PART 2 - PRODUCTS

2.01 ELECTRONIC TIME SWITCHES

- A. Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 1. Contact Configuration: SPST.
 2. Contact Rating: 30-A inductive or resistive, 240-V ac 20-A ballast load, 120/240-V ac.

3. Astronomical Clock: Capable of switching a load on at sunset and off at sunrise, and automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Additionally, it shall be programmable to a fixed on/off weekly schedule.
4. Battery Backup: For schedules and time clock.

2.02 ELECTROMECHANICAL-DIAL TIME SWITCHES

- A. Electromechanical-dial time switches; complying with UL 917.
 1. Contact Configuration: SPST.
 2. Contact Rating: 30-A inductive or resistive, 240-V ac and 20-A ballast load, 120/240-V ac.
 3. Wound-spring reserve carryover mechanism to keep time during power failures.

2.03 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Solid state, with SPST dry contacts rated for 1800 VA tungsten or 1000 VA inductive, complying with UL 773A.
 1. Light-Level Monitoring Range: 1.5 to 10 fc [16.14 to 108 lx], with adjustable turn-on and turn-off levels.
 2. Time Delay: 15-second minimum.
 3. Surge Protection: Metal-oxide varistor.
 4. Mounting: Twist lock, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

2.04 TIMER SWITCHES

- A. Digital switches with backlit LCD display, 120/277 volt rated, fitting as a replacement for standard wall switches.
 1. Compatibility: Compatible with all ballasts.
 2. Warning: Audible warning to sound during the last minute of "on" operation.
 3. Time-out: Adjustable from 5 minutes to 12 hours.
 4. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

2.05 OUTDOOR MOTION SENSOR (PIR)

- A. Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C).
 1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a 1 to 15 minute adjustable time delay for turning lights off.
 2. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.

- b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 3. Bypass Switch: Override the on function in case of sensor failure.
 - 4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc [11 to 215 lx]; keep lighting off during daylight hours.
- B. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm].
- C. Detection Coverage: as scheduled on drawings.
- D. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 1. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
 - 2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.09 LIGHTING CONTROL PANEL – RELAY TYPE

- A. Controller: Comply with UL 508; programmable, solid-state, astronomic 365-day control unit with non-volatile memory, mounted in preassembled relay panel with low-voltage-controlled, latching-type, single-pole lighting circuit relays. Controller shall be capable of receiving inputs from sensors and other sources, and capable of timed overrides and/or blink-warning on a per-circuit basis. Controller communication protocol shall be compatible with the building automation system specified in SECTION 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays.
- B. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.
- C. Directory: Identifies each relay as to load controlled.
- D. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
- E. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125-V ac for tungsten filaments and 20 A, 277-V ac for ballasts, 50,000 cycles at rated capacity.

2.10 LIGHTING CONTROL PANEL – CIRCUIT BREAKER TYPE

- A. Controller: Panelboard mounted in compliance with UL 916, programmable, solid-state, astronomic 365-day timing and control unit with non-volatile memory. Controller shall be integral to panelboard as specified in Section 26 24 16, PANELBOARDS. Controller

shall be capable of receiving inputs from sensors and other sources, and capable of timed overrides and/or blink-warning on a per-circuit basis. Controller communication protocol shall be compatible with the building automation system specified in SECTION 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Panelboard shall use low-voltage-controlled, electrically operated molded-case branch circuit breakers or molded-case branch circuit breakers with switching accessories. Circuit breakers and a limited number of digital or analog, low-voltage control-circuit outputs shall be individually controlled by control module. Panelboard shall also comply with Section 24 26 16, PANELBOARDS.

- B. Electrically Operated, Molded-Case Circuit-Breaker Panelboard: Per Section 24 26 16, PANELBOARDS.
- C. Electrically Operated, Molded-Case Circuit Breakers: Per Section 26 24 16, PANELBOARDS.
- D. Switching Endurance Ratings: Rated at least 20,000 open and close operations under rated load at 0.8 power factor.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Aim outdoor photocell switch according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle photocell turn-on.
- C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.
- D. Set occupancy sensor "on" duration to 15 minutes.
- E. Locate light level sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the scheduled light level at the typical work plane for that area.
- F. Label time switches and contactors with a unique designation.

3.02 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.
- E. Program lighting control panels per schedule on drawings.

- F. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory-authorized technician who will verify all adjustments and sensor placements.

3.03 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

- - - END OF SECTION - - -

**SECTION 26 56 00
EXTERIOR LIGHTING**

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior luminaires, poles, and supports.

1.02 RELATED WORK

- A. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for exterior light poles and luminaires.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- G. Section 26 09 23, LIGHTING CONTROLS: Controls for exterior lighting.

1.03 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.04 SUBMITTALS

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
 - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
 - 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaires, lamps, and accessories.
- C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the CONTRACTING OFFICER'S REPRESENTATIVE. Include

technical data sheets, wiring and connection diagrams, and information for ordering replacement lamps, ballasts, and parts.

- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the CONTRACTING OFFICER'S REPRESENTATIVE:
1. Certification by the manufacturer that the materials are in accordance with the drawings and specifications.
 2. Certification by the contractor that the complete installation has been properly installed and tested.

1.05 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Aluminum Association Inc. (AA):
AAH35.1-06.....Alloy and Temper Designation Systems for Aluminum
- C. American Association of State Highway and Transportation Officials (AASHTO):
LTS-5-09Structural Supports for Highway Signs, Luminaires and Traffic Signals
- D. American Concrete Institute (ACI):
318-05Building Code Requirements for Structural Concrete
- E. American National Standards Institute (ANSI):
C81.61-09Electrical Lamp Bases – Specifications for Bases (Caps) for Electric Lamps
- F. American Society for Testing and Materials (ASTM):
A123/A123M-09Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M-09Zinc Coating (Hot-Dip) on Iron and Steel Hardware
B108-03a-08Aluminum-Alloy Permanent Mold Castings
C1089-06Spun Cast Prestressed Concrete Poles
- G. Federal Aviation Administration (FAA):
AC 70/7460-IK-07Obstruction Lighting and Marking
AC 150/5345-43F-06Obstruction Lighting Equipment
- H. Illuminating Engineering Society of North America (IESNA)
HB-9-00Lighting Handbook
RP-8-05Roadway Lighting
RP-20-98Lighting for Parking Facilities
RP-33-99Lighting for Exterior Environments
LM-5-96Photometric Measurements of Area and Sports Lighting Installations

- LM-50-99 Photometric Measurements of Roadway Lighting Installations
- LM-52-99 Photometric Measurements of Roadway Sign Installations
- LM-64-01 Photometric Measurements of Parking Areas
- LM-72-97 Directional Positioning of Photometric Data
- LM-79-08 Approved Method for the Electrical and Photometric
Measurements of Solid-State Lighting Products
- LM-80-08 Approved Method for Measuring Lumen Maintenance of LED
Light Sources
- I. National Electrical Manufacturers Association (NEMA):
 - C78.41-06 Electric Lamps – Guidelines for Low-Pressure Sodium Lamps
 - C78.42-07 Electric Lamps – Guidelines for High-Pressure Sodium Lamps
 - C78.43-07 Electric Lamps – Single-Ended Metal-Halide Lamps
 - C78.1381-98 Electric Lamps – 70-Watt M85 Double-Ended Metal-Halide
Lamps
 - C82.4-02 Ballasts for High-Intensity-Discharge and Low-Pressure Sodium
Lamps (Multiple-Supply Type)
 - C136.3-05 For Roadway and Area Lighting Equipment – Luminaire
Attachments
 - C136.17-05 Roadway and Area Lighting Equipment – Enclosed Side-
Mounted Luminaires for Horizontal-Burning High-Intensity-
Discharge Lamps – Mechanical Interchangeability of Refractors
 - ICS 2-00 (R2005) Controllers, Contactors and Overload Relays Rated 600 Volts
 - ICS 6-93 (R2006) Enclosures
- J. National Fire Protection Association (NFPA):
 - 70-08 National Electrical Code (NEC)
- K. Underwriters Laboratories, Inc. (UL):
 - 496-08 Lampholders
 - 773-95 Plug-In, Locking Type Photocontrols for Use with Area Lighting
 - 773A-06 Nonindustrial Photoelectric Switches for Lighting Control
 - 1029-94 High-Intensity-Discharge Lamp Ballasts
 - 1598-08 Luminaires
 - 8750-08 Light Emitting Diode (LED) Light Sources for Use in Lighting Products

1.06 DELIVERY, STORAGE, AND HANDLING

Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 12 in [305 mm] above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.02 LUMINAIRES

- A. Per UL 1598 and NEMA C136.17. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.
- B. Light distribution pattern types shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.
- D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Pre-wire internal components to terminal strips at the factory.
- F. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.
- G. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- H. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
- I. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.03 LAMPS

- A. Install the proper lamps in every luminaire installed and every existing luminaire relocated or reinstalled.
- B. Lamps shall be general-service, outdoor lighting types.
- C. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40° F [-40° C] and 120° F [50° C].
 - 2. Correlated Color Temperature (CCT): 3000K.
 - 3. Color Rendering Index (CRI): ≥ 80.
 - 4. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL),

Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).

- D. Mercury vapor lamps shall not be used.

2.04 LED DRIVERS

- A. LED drivers shall meet the following requirements:
1. Drivers shall have a minimum efficiency of 85%.
 2. Starting Temperature: -40° F [-40° C].
 3. Input Voltage: 120 to 480 (±10%) V.
 4. Power Supplies: Class I or II output.
 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μs, 10kA/8 x 20 μs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 6. Power Factor (PF): ≥ 0.90.
 7. Total Harmonic Distortion (THD): ≤ 20%.
 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

2.05 EXISTING LIGHTING SYSTEMS

- A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Install lamps in each luminaire.
- C. Adjust luminaires that require field adjustment or aiming.

3.02 GROUNDING

Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.03 ACCEPTANCE CHECKS AND TESTS

Verify operation after installing luminaires and energizing circuits.

--- END OF SECTION---

**SECTION 31 20 00
EARTHWORK**

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:
1. Site preparation.
 2. Excavation.
 3. Underpinning.
 4. Filling and backfilling.
 5. Grading.
 6. Soil Disposal.
 7. Clean Up.

1.02 DEFINITIONS

- A. Unsuitable Materials:
1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D1557.
 2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
 3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to Contracting Officer's Representative's approval.
- B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.
- C. Trench Earthwork: Trenchwork required for utility lines.
- D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.
- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D6938.
- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or

indicated lines and dimensions without written authorization by the Contracting Officer's Representative. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.

- I. Authorized additional excavation: Removal of additional material authorized by the Contracting Officer's Representative based on the determination by the Government's soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.
- R. Contaminated soils: Soil that contains contaminants as defined and determined by the Contracting Officer's Representative or the Government's testing agency.

1.3 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- E. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.
- F. Site preparation: Section 02 41 00, DEMOLITION.

- G. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

1.4 CLASSIFICATION OF EXCAVATION:

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION

- A. Measurement: The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. Quantities should be computed by a Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. The measurement will include authorized excavation of satisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to taking of elevations and measurements of the undisturbed grade.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Furnish to Contracting Officer's Representative:
1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.
 2. Soil samples.
 - a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
 - b. Laboratory compaction curve in accordance with ASTM D1557 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
 - c. Test reports for compliance with ASTM D2940 requirements for subbase material.
 - d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.
 - e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.
 3. Contractor shall submit procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

1.8 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T99-10..... Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
 - T180-10..... Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop
- C. American Society for Testing and Materials (ASTM):
 - C33-03..... Concrete Aggregate
 - D448-08..... Standard Classification for Sizes of Aggregate for Road and Bridge Construction
 - D698-07e1..... Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN m/m³))
 - D1140-00..... Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
 - D1556-07..... Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
 - D1557-09..... Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2700 kN m/m³))
 - D2167-08..... Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
 - D2487-11..... Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - D2940-09..... Standard Specifications for Graded Aggregate Material for Bases or Subbases for Highways or Airports
 - D6938-10..... Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D. Society of Automotive Engineers (SAE):
 - J732-07 Specification Definitions - Loaders
 - J1179-08 Hydraulic Excavator and Backhoe Digging Forces

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (2.5 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), and a Plasticity Index no greater than 15.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75- μ m (No. 200) sieve, per ASTM D2940.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75- μ m (No. 200) sieve.
- E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.
- F. Granular Fill:
1. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), per ASTM D2940.
- G. Buried Warning and Identification Tape: Metallic core or metallic-faced, acid- and alkali-resistant polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:
- | | |
|---------|------------------------------------|
| Red: | Electric |
| Yellow: | Gas, Oil, Dangerous Materials |
| Orange: | Telephone and Other Communications |
| Blue: | Water Systems |
| Green: | Sewer Systems |
- H. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.
- I. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m (3 feet)

deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

- J. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Medical Center.
- B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by Contracting Officer's Representative. Remove materials from Medical Center. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, that are to remain, than farthest extension of their limbs.
- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by Contracting Officer's Representative. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.
- E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Medical Center.
- F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.
1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
 2. Locations of existing elevations indicated on plans, except spot elevations, are from multiple site surveys that measured spot elevations and subsequently

- generated existing contours and spot elevations. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify Contracting Officer's Representative of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Contracting Officer's Representative of any differences between existing or constructed grades, as compared to those shown on the plans.
3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
 4. Finish grading is specified in Section 32 90 00, PLANTING.
- G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.02 EXCAVATION

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Contracting Officer's Representative, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
1. Design of the temporary support of excavation system is the responsibility of the Contractor. The Contractor shall submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheet piling shall be removed as excavations are backfilled, in a manner to prevent caving.
 2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Contracting Officer's Representative.
 3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
 4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall underpin the existing foundation, per Section 3.3, or provide a concrete fill support in compliance with specifications Section 31 23 23.33, FLOWABLE FILL, under disturbed foundations, as directed by Contracting Officer's Representative, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Contracting Officer's Representative.
 5. The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheet piling and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Contracting Officer's Representative of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Contracting Officer's Representative at any

time throughout the contract duration.

- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Contracting Officer's Representative. Approval by the Contracting Officer's Representative is also required before placement of the permanent work on all subgrades. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m (3 feet) of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least one foot below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in pervious zones below subgrade elevation in layered soils to prevent uplift.
- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Contracting Officer's Representative.
- D. Proofrolling:
1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
 2. Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a 13.6 meter tons (15 ton), pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour (2 1/2 to 3 1/2 mph). When proof rolling, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Contracting Officer's Representative a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer's Representative. Rutting or pumping of material shall be undercut as directed by the Contracting Officer's Representative and replaced with select material. Maintain subgrade until succeeding operation has been accomplished.
- E. Trench Earthwork:
1. Sanitary and storm sewer trenches:
 - a. Trench width below a point 150 mm (6 inches) above top of pipe shall be 600 mm (24 inches) maximum for pipe up to and including 300 mm (12 inches) diameter, and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.

OSHA requirements, and for inspections. Remove subgrade materials that are determined by Contracting Officer's Representative as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the Contracting Officer's Representative, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.

1. Site Grading:
 - a. Provide a smooth transition between adjacent existing grades and new grades.
 - b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 - c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
 - i. Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
 - ii. Walks: Plus or minus 25 mm (1 inch).
 - iii. Pavements: Plus or minus 13 mm (1/2 inch).
 - d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

3.03 UNDERPINNING

- A. Design of the underpinning system is the responsibility of the Contractor and should be designed by a registered professional engineer and is subject to review and approval by the Contracting Officer's Representative. Underpinning of existing building foundations, as indicated on structural drawings, or where excavation undermines existing foundations, shall be accomplished in the following manner:
 1. Make general excavation for new construction, where new foundations are to be below existing foundations, to elevation of new foundations (or sized stone subbase), maintaining a 45 degree sloped berm.
 2. For underpinning pits, underpin existing wall foundations by excavating 1200 mm (4 feet) wide pits to depth shown on drawings skipping 3 sections at any one time so as to maintain support for wall at all times.
 3. Underpin intervening sections one at a time; no adjacent sections shall be underpinned until concrete in adjacent sections shall have reached 20 MPa (2500 psi) strength and have been dry packed with non-shrink grout to obtain positive bearing. Sheet and brace underpinning pits if soil will not stand on a vertical cut during this operation, or as required for safety of workmen. Repack any voids behind sheeting to prevent sloughing which could cause settlement of existing foundations. Contractor performing this portion of work shall have been prequalified by Contracting Officer's Representative as having previously performed successfully this type of work or will demonstrate his capability for successfully performing this work. It shall be sole responsibility of the Contractor to guard against objectionable movement or settlement and to preserve integrity of existing structures.
 4. The tip elevation of the underpinning pits shall be a minimum of 900 mm (3 feet) below the adjacent excavation elevation.
 5. Subgrades at the tip of the underpinning pit shall be clean, dry, and free of debris and shall be observed by the Contracting Officer's Representative prior to concrete placement.
 6. Concrete shall not be free fall greater than 3000 mm (10 feet) into the pit.

3.4 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Contracting Officer's Representative.
- B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Compact with approved tamping rollers, sheepfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of Contracting Officer's Representative. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:
1. Fills, Embankments, and Backfill
 - a. Under proposed steps, and paved areas, see geotechnical report.
 - a. Curbs, curbs and gutters, see geotechnical report.
 - b. Under Sidewalks, see geotechnical report.
 - c. Landscaped areas, top 400 mm (16 inches), see geotechnical report.
 - d. Landscaped areas, below 400 mm (16 inches) of finished grade, see geotechnical report.
 2. Natural Ground (Cut or Existing)
 - a. Under steps and paved areas, see geotechnical report.
 - b. Curbs, curbs and gutters, top 150 mm (6 inches), see geotechnical report.
 - c. Under sidewalks, top 150 mm (6 inches), see geotechnical report.
- D. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas within the limits of the project site, selected by the Contractor or from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

- E. Opening and Drainage of Excavation and Borrow Pits: The Contractor shall notify the Contracting Officer's Representative sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.05 GRADING

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 1800 mm (6 feet).
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
- E. Finished grade shall be at least 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is shown.
- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.
- G. Finish subgrade in a condition acceptable to Contracting Officer's Representative at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.
- H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.06 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- D. Segregate all excavated contaminated soil designated by the Contracting Officer's Representative from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State

and Local requirements.

3.07 CLEAN UP

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Medical Center.

--- END OF SECTION---

**SECTION 31 23 23.33
FLOWABLE FILL**

PART 1 - GENERAL

1.01 INTRODUCTION

- A. Flowable fill refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used as a fill or backfill in lieu of compacted earth. This mixture is capable of filling all voids in irregular excavations and hard to reach places, is self-leveling, and hardens in a matter of a few hours without the need for compaction in layers. Flowable fill is sometimes referred to as controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable fill.
- B. Flowable fill materials will be used as only as a structural fill replacement on VA projects. The materials and mix design for the flowable fill should be designed to produce a comparable compressive strength to the surrounding soil after hardening, making excavation at a later time possible Contracting Officer's Representative

1.02 DESCRIPTION

Furnish and place flowable fill in a fluid condition, that sets within the required time and, after curing, obtains the desired strength properties as evidenced by the laboratory testing of the specific mix design, at locations shown on the plans or as directed by the Contracting Officer's Representative, verbally or in writing. This section specifies flowable fill for use as structural fill to remain excavatable using hand tools.

1.03 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Earthwork, excavation and backfill and compaction requirements: Section 31 20 00, EARTHWORK.

1.04 DEFINITIONS

- A. Flowable fill - Ready-mix Controlled Low Strength Material used as an alternative to compacted soil, and is also known as controlled density fill, and several other names, some of which are trademark names of material suppliers. Flowable fill (Controlled Low Strength Material) differs from portland cement concrete as it contains a low cementitious content to reduce strength development for possible future removal.
- B. Excavatable Flowable fill – flowable fill designed with a compressive strength that will allow excavation as either machine tool excavatable at compressive strength of 1.5 MPa (200 psi) maximum at 1 year, or hand tool excavatable at compressive strength of 0.7 MPa (100 psi) maximum at 1 year.

1.05 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Flowable fill Mix Design: Provide flowable fill mix design containing cement and water. At the contractor's option, it may also contain fly ash, aggregate, or chemical admixtures in any proportions such that the final product meets the strength and flow consistency, and

shrinkage requirements included in this specifications. The mix design should state the sources and proportions of each of the flowable fill constituents. The coefficient of permeability of flowable fill shall be that of uniform fine sand, 4.0×10^{-1} cm/sec (0.16 in/sec) or as indicated to provide a backfill material with permeability equal to or greater than that of the surrounding soil.

1. Test and Performance - Submit the following data:
 - a. Flowable fill shall have a minimum strength of 2.1 MPa (300 psi) according to ASTM C 39 at 28 days after placement.
 - b. Flowable fill shall have minimal subsidence and bleed water shrinkage. Evaporation of bleed water shall not result in shrinkage of more than 10.4 mm per m (1/8 inch per ft.) of flowable fill depth (for mixes containing high fly ash content). Measurement of a Final Bleeding shall be as measured in Section 10 of ASTM C 940 "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - c. Flowable fill shall have a unit weight of 1900 – 2300 kg/m³ (115 – 145 lb/feet³) measured at the point of placement after a 60 minute ready-mix truck ride.
- C. Provide documentation that the admixture supplier has experience of at least one year, with the products being provided and any equipment required to obtain desired performance of the product.

1.06 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - D4832-10..... Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
 - C618-12..... Standard Specifications for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete. (Use Fly Ash conforming to the chemical and physical requirements for mineral admixture, Class F listed, including Table 2 (except for Footnote A). Waive the loss on ignition requirement.)
 - C403/C403M-08 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
 - C150/C150M-11 Standard Specification for Portland Cement
 - C33/C33M-11a Standard Specification for Concrete Aggregates
 - C94/C94M-12 Standard Specification for Ready-Mixed Concrete
 - C494/C494M-11 Standard Specification for Chemical Admixtures for Concrete
 - C685/C685M-11 Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing

- C940-10a.....Standard Specification for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced – Aggregate Concrete in the Laboratory
- D5971.....Sampling Freshly Mixed Controlled Low Strength Material
- D6103.....Flow Consistency of Controlled Low Strength Material
- D6023.....Unit Weight, Yield, Cement Content and Air Content (Gravimetric) of Controlled Low Strength Material
- C. American Concrete Institute (ACI):
 - SP-150-94Controlled Low-Strength Materials

1.07 QUALITY ASSURANCE

- A. Manufacturer: Flowable fill shall be manufactured by a ready-mix concrete producer with a minimum of 1 year experience in the production of similar products.
- B. Materials: For each type of material required for the work of this Section, provide primary materials that are the products of one manufacturer. If not otherwise specified here, materials shall comply with recommendations of ACI 229, “Controlled Low Strength Materials.”
- C. Pre-Approval Procedures: The use of flowable fill during any part of the project shall be restricted to those incidences where, due to field conditions, the Contractor has made the Contracting Officer's Representative aware of the conditions for which he recommends the use of the flowable, and the Contracting Officer's Representative has confirmed those conditions and approved the use of the flowable fill, in advance. During the submittal process, the contractor shall prepare and submit various flowable fill mix designs corresponding to required conditions or if the contractor desires to use flowable fill due to economics. Approval for the strength of the flowable fill shall be obtained from the Contracting Officer's Representative when the contractor desires, or is required, to use flowable fill at specific location(s) within the project. Prior to commencement of field operations the contractor shall establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- D. Sampling and Acceptance: Flowable fill shall be samples and testing in the field in conformance with either ASTM C 94 or C 685. Samples for tests shall be taken for every 115 cubic meters (150 cubic yards) of material, or fraction thereof, for each day's placement. Tests shall include temperature reading and four compressive strength cylinders. Compressive strength sampling and testing shall conform to ASTM D 4832 with one specimen tested at 7 days, two at 28 days, and one held for each batch of four specimens. Sampling and testing shall be performed by a qualified, independent commercial testing laboratory. Test results should be submitted within 48 hours of completion of testing.

1.08 DELIVERY, STORAGE, AND HANDLING

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

1.09 PROJECT CONDITIONS

Perform installation of flowable fill only when approved by the Contracting Officer's Representative, and when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide flowable fill containing, at a minimum, cementitious materials and water. Cementitious materials shall be portland cement, pozzolanic materials, or other self-cementing materials, or combinations thereof, at the contractor's option, and following approval by the Contracting Officer's Representative. The flowable fill mix design may also contain, fine aggregate or filler, and/or chemical admixtures in any proportions such that the final product meets the strength, flow consistency and shrinkage requirements included in this specification, as approved by the Contracting Officer's Representative.
- B. Portland Cement: ASTM C150, Type 2, meeting Section 90 of the Caltrans Standard Specifications. //
- C. Mixing Water: Fresh, clean, and potable, meeting _____ Section 90 of the Caltrans Standard Specifications.
- D. Air-Entraining Admixture: ASTM C260 meeting Section 90 of the Caltrans Standard Specifications.
- E. Chemical Admixtures: ASTM C494 meeting Section 90 of the Caltrans Standard Specifications.
- F. Aggregate: ASTM C33 meeting Section 90 of the Caltrans Standard Specifications.

2.02 FLOWABLE FILL MIXTURE

- A. Mix design shall produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place.
- B. Flowable fill shall have a minimum strength of 200 psi according to ASTM C39 at 28 days after placement.
- C. Flowable fill shall have minimal subsidence and bleed water shrinkage. Evaporation of bleed water shall not result in shrinkage of more than 10.4 mm per m (1/8 inch per foot) of flowable fill depth (for mixes containing high fly ash content). Measurement of a Final Bleeding shall be as measured in Section 10 of ASTM C 940 "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
- D. Flowable fill shall have a unit weight of 1900 – 2300 kg/m³ (115 – 145 lbs/feet³) measured at the point of placement after a 60 minute ready-mix truck ride. In the absence of strength data the cementitious content shall be a maximum of 90 kg/m³ (150 lbs/cy).
- E. Flowable fill shall have an in-place yield of at least 98% of design yield for permanent type.

- F. Provide equipment as recommended by the Manufacturer and comply with manufacturer's recommendations for the addition of additives, whether at the production plant or prior to placement at the site.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 APPLICATION OF FLOWABLE FILL

Secure tanks, pipes and other members to be encased in flowable fill. Insure that there are no exposed metallic pipes, conduits, or other items that will be in contact with the flowable fill after placement. If so, replace with non-metallic materials or apply manufacturers recommended coating to protect metallic objects before placing the flowable fill. Replacement or protection of metallic objects is subject to the approval of the Contracting Officer's Representative.

3.03 PROTECTION AND CURING

Protect exposed surfaces of flowable fill from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by Contracting Officer's Representative.

--- END OF SECTION---

SECTION 31 63 26
DRILLED CAISSONS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies excavation and concrete required for construction of foundation caissons.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements and blasting operations: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA
- D. Earth excavation: Section 31 20 00, EARTH MOVING.
- E. Concrete, including materials and mixes: Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.3 CONTRACT BASIS

- A. Contract price for caissons will be based upon total length for each type of caisson shown. Length of caissons will be measured from bottom elevation to top elevation of the caisson. The diameter of the caisson is defined as the minimum diameter of the shaft.
 - 1. Adjustment of contract price shall be based upon total length of each type of caisson placed and not on the length of individual caissons. When the total length of each type of completed caisson is greater or less than the length shown due to unsuitable soils or design modifications by the Resident Engineer, contract price adjustment will be made in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.
 - 2. Contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable, when artificial materials that are not shown are encountered.

1.4 CLASSIFICATION OF EXCAVATION

- A. Soil/Weathered Rock Excavation:

Soil or weathered rock that can be reasonably excavated with the rock auger, i.e. rock auger advancement greater than 150 mm (6 inches) per 15 minutes (see rock auger refusal, 1.5.C-2, below)

B. Sloping Weathered Rock Excavation:

Excavation of soil/weathered rock that can typically be excavated with the rock auger, except when the steeply sloping orientation of the stratum causes the rock auger to run askew.

C. Rock Excavation:

1. Excavation of material that meets the rock auger refusal criteria and requires the rock core barrel or other hard rock excavation techniques for removal.

2. Rock auger refusal is defined as a penetration rate of less than 150 mm (6 inches) in 15 minutes, while operating a caisson drilling rig, rated with a torque capacity of at least 110 kN-meters (1,000,000 inch-pounds), applying a continuous down pressure of at least 220 kN (50,000 pounds), equipped with a rock auger that contains conical carbide-tipped ("Kennemetal") teeth.

D. Nominal Soil or Weathered Rock Seams:

Nominal soil or weathered rock seams below rock auger refusal will be excavated and considered as rock for rock excavation quantities. A nominal soil or weathered rock seam is one which is less than 600 mm (2 feet) thick. Where soil or weathered rock seams or voids of 600 mm (2 feet) or greater are excavated within a mixed rock/soil or rock/weathered rock profile, excavation is classified as soil/weathered rock excavation until rock auger refusal is again established.

1.5 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION

A. Measurement: Excavation type in units of length shall be considered to change at the upper contact with a different excavation type as defined by section 1.5.

B. Payment: Contract unit rates per length of each type of caisson shall be provided for each excavation condition type noted above in Section 1.5. Contract price and time will be adjusted for overruns or underruns in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.

C. Payment for Differing Site Conditions: No payment will be made for any rock excavation beyond caisson limits unless additional excavation is directed by the Resident Engineer. When rock excavation, as

classified, is encountered, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.

1.6 TOLERANCES

Install caissons with not more than the lesser of 1/24th of caisson shaft diameter or 75 mm (3 inches) from design center location.

Caissons shall not be out of plumb more than 25 mm (1 inch) in 3000 mm (10 feet) for the full depth. Cross sections of shafts and bells shall not be less than design dimensions. Batter caissons shall be installed a maximum of 2 percent of length from specified inclination.

1.7 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Before beginning work, submit a detailed location plan and description of the proposed method of caisson installation, all of which shall be subject to the review and approval of the Resident Engineer.
- C. Shop Drawings shall comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Furnish shop drawings prepared by a Professional Engineer licensed in the State of the project for the detailing, fabricating, bending, and placing of concrete reinforcement.
- D. Reports:
 1. Caisson record: Data as specified.
 2. Rock excavation: Data as specified.
 3. Certified, "Caisson Field Record" for each caisson recording actual elevation of bottom, elevation of rock (if applicable), final centerline location of top, variation of shaft from plumb, bell dimension (if applicable), result of all tests and observations performed, material type and actual allowable bearing capacity of bottom, depth of socket into rock, levelness of bottom, seepage of water, still water level (if allowed to flood), elevation (top and bottom) of lining left in place, variation of shaft diameter (from those shown), and evidence of seams, voids or channels below bottom.
- E. Certificates: Contractor's qualifications as specified: Experienced specialty piling subcontractor having a minimum of 5 years successful experience installing Work of the same type required for this project.

Employ only skilled tradesmen who are thoroughly experienced with the materials and equipment to be used in the Work.

- F. Upon completion of caisson installations, the Contractor shall submit five copies of drawings indicating actual in-place pile locations. The Contractor shall pay for all surveying costs. Drawings must be submitted prior to beginning any pile cap or mat installation. One electronic copy of the drawings shall be submitted in AutoCAD DWG format on CD-ROM.
- G. Record drawings at Project closeout according to Division 01 Section "Closeout Procedures."

1.8 QUALITY CONTROL

- A. Contractor's Quality Control Responsibilities: Contractor is solely responsible for quality control of the Work.
- B. A Quality Control Program shall be submitted by the Contractor at least two weeks prior to the commencement of work. The implementation of a Contractor Quality Control Program does not relieve the Contractor from the responsibility to provide work in accordance with the Contract Documents, applicable codes, regulations, and Governing Authorities.
- C. Contractor's Independent Testing and Inspection Agency (Agency): The Contractor shall retain at his own expense, the services of a qualified Independent Testing and Inspection Agency, licensed in the state of the project, to provide testing and inspection services during the installation of all foundation piling involved in this Work. This firm shall also provide consultation services to the Contractor if problems are encountered during the execution of the Work. The Agency shall be primarily concerned with the testing and construction methods which will result in finished foundation piling of the required quality and strength. The Agency shall also be concerned with preventing settlement and/or damage to surrounding structures, roads, utilities, embankments, etc., both within the property lines and on adjoining properties during the construction.
- D. The Agency shall be experienced in the testing and installation of caisson foundations. It shall have been involved in at least 8 different caisson projects in the last 5 years, and shall have experience in recommending, testing, and specifying caissons for similar subsurface conditions.

- E. Survey Work: The Contractor shall engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for caissons. The surveyor shall record actual measurements of each caisson's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
- F. Contractor's Grout Mix Designer: The Contractor shall employ, at his own expense, a testing laboratory to design grout mixes, conduct tests and submit reports for the design mixes. The Grout Mix Designer shall be qualified according to ASTM C1077 and ASTM E329 to perform material evaluation tests and to design concrete mixes, as documented according to ASTM E548.
- G. Welding Standards: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1
 - 2. AWS D1.4
- H. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

1.9 QUALITY ASSURANCE

- A. The Owner shall retain the services of a Geotechnical Consultant (Consultant) to provide general observation of all pile operations and to provide technical advice to the Owner with regard to pile operations and performance.
- B. The Consultant shall have been involved in at least 8 different caisson installation projects in the last 5 years, and shall have experience in recommending, testing, and specifying caissons for similar subsurface conditions.

1.10 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A36/A36M-08.....Standard Specification for Carbon Structural Steel
 - A283/A283M-03(2007).....Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

- A615/A615M-09b.....Standard Specification for Deformed and Plain
Carbon Steel Bars for Concrete Reinforcement
- A929/A929M-01(2007).....Standard Specification for Steel Sheet,
Metallic Coated by the Hot Dip Process for
Corrugated Steel Pipe
- A996/A996M-09b.....Standard Specification for Rail Steel and Axle
Steel Deformed and Bars for Concrete
Reinforcement
- C33-11a.....Standard Specification for Concrete Aggregates
- C94/C94M-12.....Standard Specification for Ready Mixed Concrete
- C150-C50M-11.....Standard Specification for Portland Cement
- C494/C494M-11.....Standard Specification for Chemical Admixtures
for Concrete
- C618-12.....Standard Specification for Coal Fly Ash and Raw
or Calcined Natural Pozzolan for Use in
Concrete
- C989-C989M-11.....Standard Specification for Slag Cement for Use
in Concrete and Mortars
- C1017/C1017M-07.....Standard Specification for Chemical Admixtures
for Use in Producing Flowing Concrete
- D1143-81(1994)e1.....Standard Test Method for Piles Under Static
Axial Compressive Load
- D3689-90(1995).....Standard Test Method for Individual Piles Under
Static Axial Tensile Load
- D3966-90(1995).....Standard Test Method for Piles Under Lateral
Loads
- C. American Concrete Institute (ACI):
 - 211.1-91 (2009).....Standard Practice for Selecting Proportions for
Normal, Heavyweight and Mass Concrete
 - 301-10.....Specifications for Structural Concrete
 - 315-99.....Details and Detailing of Concrete Reinforcement
- D. American Welding Society (AWS):
 - D1.1/D1.DM (2010).....Structural Welding Code - Steel
 - D1.4 (1998).....Structural Welding Code - Reinforcing Steel

2.0 MATERIALS

- A. Steel Reinforcement: ASTM A615/A615M, or 996, Grade 60, deformed.
- B. Portland Cement: ASTM C150, Type I or II.

SPEC WRITER NOTE: Select mineral or cementitious admixtures from two subparagraphs below if permitted. Ready-mix plant blends fly ash or slag with portland cement.

C. Fly Ash/Slag:

1. Fly Ash Admixture: ASTM C618, Class C or F.
2. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

D. Normal-Weight Aggregate: ASTM C33, uniformly graded, 19 mm (3/4-inch) maximum aggregate size.

E. Water: Potable, complying with ASTM C94/C94M requirements.

F. Admixtures: Certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
3. High-Range, Water-Reducing Admixture: ASTM C494, Type G.
4. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

G. Steel Casings: All casing shall meet ASTM A283, Grade C; or ASTM A36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1, or ASTM A929/A929M, steel sheet, zinc coated corrugated steel. The Contractor shall design shells to withstand drilling forces and earth pressures and reinforce the bottom cutting edge as required for proper drilling and sealing of the shells into the rock. The cutting edge shall be capable of coring through at least 3000 mm (10 ft) of broken or solid rock. A minimum of 2% out of roundness of the diameter shall be considered in the design of the shell. All seams shall be welded and watertight

H. Concrete Mix: Prepare design mixes according to ACI 211.1 and ACI 301 for each type and strength of concrete determined by either laboratory trial mix or field test data bases. Use a qualified testing agency for preparing and reporting proposed mix designs for laboratory trial mix basis. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
2. Minimum Slump: Capable of maintaining a slump of 125 mm (5 inches) plus or minus 25 mm (1 inch).

3. Do not air entrain concrete for caissons
 4. Limit water-soluble, chloride-ion content in hardened concrete to 0.15//0.3 percent by weight of cement.
 5. Concrete-mix design adjustments may be considered if characteristics of materials, project conditions, weather, test results, or other circumstances warrant. Resubmission and approval of proposed changes to concrete-mix proportions is the responsibility of the Contractor.
- I. Concrete Mixing: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information. Do not add water to concrete mix after mixing, unless a procedure per ACI 301 is submitted to and approved by the Resident Engineer. Maintain concrete temperature less than 32 degree Celsius (90 degree Fahrenheit).

PART 3 - EXECUTION

3.0 GENERAL

- A. Size: Minimum sizes and types of caissons are shown. Proposal to use caissons of sizes and types different from those shown may be accepted if submitted in writing to Resident Engineer for approval and provided the following conditions are met:
1. Least dimension of caisson is equal to or greater than least dimension shown.
 2. Enlargement at base of caisson is in bell-form with dimensions equal to or greater than minimum shown.
 3. Entire caisson receives full lateral support from surrounding material.
- B. Changes: Requests for change in size or type of caisson from those shown shall be accompanied by calculations and other documentation necessary to show that proposed changes will meet load requirements. Do not proceed with changes before receiving written approval from Resident Engineer.
- C. Temporary Steel Casings: Install casings for protection of workers and inspection personnel, for prevention of cave-ins or displacement of earth walls, and for retention of ground water.
- D. Defective Casings: Do not install buckled, distorted or otherwise damaged casings. Replace casings damaged or disturbed during construction, casings that are not mud-tight or otherwise not in

accordance with drawings or specifications, at no additional cost to the Government.

- E. Survey: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and levels and stake caisson locations.

3.1 EXCAVATION

- A. Excavation and construction methods shall result in minimum disturbance of surrounding material and full lateral support of caissons by surrounding material.
- B. Remove boulders and rock in caissons such as rock seams underlain with soil seams, sloping rock or rock otherwise unsatisfactory for bearing.
- C. Excavate caissons to dimensions and elevations shown on contract drawings. Maintain sidewall stability during drilling. Excavate holes for closely spaced caissons, and those occurring in fragile strata, only after adjacent holes are filled with concrete and allowed to set. The excavation shall be accomplished by hand or machine excavation as required. Caisson drilling equipment shall have the minimum torque capacity and downward force capacity for the contract site conditions. Bottoms of caissons shall be cleaned of loose or soft materials and leveled. If bottoms are sloping rock, excavate to a level plane or step with maximum step height less than 1/4 the width or diameter of the bearing area. All material removed from the caisson holes shall be removed from the ground around the casing before concrete placement is started and shall be disposed of by the Contractor off site in areas submitted to and approved by the Engineer.
- D. Excavations for utilities, support of excavations, or other purposes shall be kept a minimum distance of two shaft diameters away from the outer edge of the caisson.

3.2 PLACING CONCRETE

- A. Before placing concrete, the tip of the caisson shall be observed and approved by a qualified testing agency registered and licensed in the state. The testing agency shall be retained by the Contractor and approved by the Resident Engineer. The shaft shall be inspected, cleared of mud, water, loose material and debris.
- B. Place concrete using a down pipe to direct flow of concrete. Except in presence of water, concrete may fall freely up to a maximum height of 9.14 meters (30 feet) provided the concrete does not hit the sides of

the caisson. Use tremie pipe or pump if distance is greater than 9.14 meters (30 feet).

- C. Withdraw casings, as concrete is deposited, maintaining top surface of concrete constantly at least 1800 mm (6 feet) above lower end of casings. Place concrete to form a monolithic cylindrical shaft having full lateral support from surrounding undisturbed materials. Strike finished top surface of concrete to true plane at required elevation.
- D. Concrete placement in each caisson shall be one continuous operation. If placing operation has to be stopped, leave surface approximately level. If concrete has hardened, clean surface and slush with a 1 to 1 cement-sand grout before placing operation is resumed. Concrete pours shall not begin within one hour of darkness. In the event that this type of continuous sequential operation cannot be performed, the Contractor shall submit for approval by the Resident Engineer a method of securing the open excavation. The Contractor shall not leave excavations open overnight without receiving prior written approval from the Resident Engineer.
- E. When water is present, control water level to within 50 mm (2 inches) of bottom of the caisson by pumping. If impossible or impractical to control water, secure written permission from Resident Engineer to place concrete through water by means of a watertight tremie.
 - 1. When placing concrete under water, discharge end of tremie shall be submerged in fresh concrete and shaft of tremie maintained full of concrete to point above water level.
 - 2. Increase cement content of concrete required to be placed in water by one sack per cubic yard of concrete.

3.3 CAISSON RECORD

- A. For each caisson placed and before superstructure framing is placed, submit to Resident Engineer for approval a certified report recording following information prepared by Registered Professional Land Surveyor or Registered Civil Engineer.
- B. Caisson number, length, and bearing material.
- C. Location.
- D. Concrete and steel reinforcement properties.
- E. Plumbness.
- F. Dates:
 - 1. Excavation completed.

2. Concrete placed.

G. Diameters:

1. Top of shaft.
2. Bottom of shaft.
3. Bell.

H. Elevations:

1. Top of ground.
2. Top of concrete.
3. Top of rock.
4. Bottom of caisson.

3.4 CLEAN UP:

- A. All debris from excavation of objectionable material, removal of obstructions, and any material not to remain as part of the construction are to be removed and disposed of by the Contractor in a legal manner at no additional cost to the Owner.
- B. The site shall be cleaned at frequent intervals and no material shall be stored on the site in a manner, which would obstruct the easy access of equipment and personnel.

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SECTION 32 05 20

CEMENT AND CONCRETE FOR LANDSCAPING EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:
- B. Walls and footings
- C. Pedestrian Pavement: Walks
- D. Concrete Maintenance Band

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- C. Concrete Walls: Section 03 30 00, CAST-IN-PLACE-CONCRETE.

1.3 DESIGN REQUIREMENTS

- A. Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

- A. Placement of concrete shall be as specified under Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

- A. The Contractor shall retain and reimburse a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the Resident Engineer, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.

1.6 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Submit two full-scale mock-up (minimum 4' by 4') sample panels of all concrete finishes and color. The samples shall include curing compound if any is to be used, and include an expansion joint and a score joint, as indicated on the Drawings. Approved samples

shall be kept at the job site to serve as a prerequisite for all finishes until acceptance of the Work.

- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Reinforcement
 - 3. Curing materials

- C. Data and Test Reports: Select subbase material.
 - 1. Job-mix formula.
 - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. M031MM031-07-UL Deformed and Plain Carbon Steel Bars for Concrete Reinforcement (ASTM A615/A615M-09)
 - 2. M055MM055-09-UL Steel Welded Wire Reinforcement, Plain, for Concrete (ASTM A185)
 - 3. M147-65-UL Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
 - 4. M148-05-UL Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
 - 5. M171-05-UL Sheet Materials for Curing Concrete (ASTM C171)
 - 6. M182-05-UL Burlap Cloth Made from Jute or Kenaf and Cotton Mats
 - 7. M213-01-UL Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
 - 8. M233-86-UL Boiled Linseed Oil Mixer for Treatment of Portland Cement Concrete
 - 9. T099-09-UL Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
 - 10. T180-09-UL Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

- C. California Department of Transportation Standard Specifications (Caltrans)

- D. American Society for Testing and Materials (ASTM):
 - 1. C94/C94M-09 Ready-Mixed Concrete
 - 2. C143/C143M-09 Slump of Hydraulic Cement Concrete

PART 2 - PRODUCTS

2.1 GENERAL

- A. Concrete shall be Type C, air-entrained as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Pedestrian Pavement	75 mm (3")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

- B. Concrete slab on grades/pavements: 3,000 PSI 28 day strength, ¾" x #4 aggregate size
- C. Portland Cement: ASTM C150, Type II, except if water or soil is high in sulfates use Type V Portland Cement as described above under Quality Assurance. Use one brand of cement throughout project.

2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.
- B. Welded wire-fabric shall conform to AASHTO M55.
- C. Dowels shall be plain steel bars conforming to AASHTO M31 . Tie bars shall be deformed steel bars conforming to AASHTO M31.

2.3 SELECT SUBBASE (AGGREGATE BASE)

- A. Aggregate base shall be Class 2, ¾ inch maximum grading, per CALTRANS Specifications, and free from vegetable matter or other deleterious substances. The percentage composition by weight of aggregate base shall conform to Section 26 of the CALTRANS Standard Specifications.
- B. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 COLOR ADDITIVES

- A. Concrete Paving shall be integrally colored.
- B. Concrete Maintenance Band shall be integrally colored.
- C. Color Additives/Pigments: Insoluble minerals, light fast, at least 95 percent passing #325 sieve complying with ASTM C979: Match Davis Colors, Los Angeles, CA ;(800) 356-4848; Color(s) shall be as shown on Drawings.
- D. Color additives containing carbon black are not acceptable.

2.6 CURING COMPOUNDS FOR COLORED CONCRETE

- A. Curing Compound for Colored Concrete: Water-base acrylic type, free of permanent color, oil or wax, complying with ASTM C309: Match Davis Colors, Los Angeles, CA (800) 356-4848; or equal.

2.7 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 - 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
 - 2. Impervious Sheeting conforming to AASHTO M171.
 - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 2 and shall be free of paraffin or petroleum.

2.8 ANCILLARY MATERIALS

- A. Fiber Expansion Joint: A non-extruding resilient filler, saturated with high quality bituminous materials having preserving characteristics. Conform to ASTM-D1751-04.
- B. Caulked Expansion Joint: "Sonolastic Sealant Two-Part" as manufactured by Sonneborn-Contech, Building Products Division, Contech, Inc.; or approved equal. Joint caps or bond breaker tape to be as recommended by sealant manufacturer. Color shall be Sikaflex 2C "Capitol Tan", or approved equal. Submit color samples for approval.
- C. Dampproofing: Per CALTRANS standard specifications, section 54.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE (WHERE REQUIRED)

- A. Mixing: Proportion the select subbase by weight or by volume in quantities so that the final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase course has been placed and compacted. Add water in approved quantities, measured by weight or volume, in such a manner to produce a uniform blend.
- B. Placing:
1. Place the mixed material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 200 mm (8 inches), and that when compacted, will produce a layer of the designated thickness.
 2. When the designated compacted thickness exceeds 150 mm (6 inches), place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
 3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
 4. If the elevation of the top layer is 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) in compacted thickness.
- C. Compaction:
1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
 2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
 3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by AASHTO T180 or AASHTO T99 respectively.
- D. Smoothness Test and Thickness Control: Test the completed subbase for grade and cross section with a straight edge.
1. The surface of each layer shall not show any deviations in excess of 10 mm (3/8 inch).
 2. The completed thickness shall be within 13 mm (1/2 inch) of the thickness as shown.
- E. Protection:
1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
 2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the VA.

3.3 SETTING FORMS

- A. Base Support:
1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

- B. Setting:
1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
 2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
 3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
 4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
 5. Clean and oil forms each time they are used.
- C. The Contractor's Registered Professional Land Surveyor, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.
1. Make necessary corrections to forms immediately before placing concrete.
 2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

- A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 PLACING REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the Resident Engineer shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.6 PLACING CONCRETE - GENERAL

- A. Obtain approval of the Resident Engineer before placing concrete.
- B. Plain non-colored, exposed concrete shall contain lampblack, approximately 3/4 pound of lampblack per cubic yard, as accepted by Resident Engineer.
- C. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Resident Engineer before placing concrete.
- D. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- E. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.

- F. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- G. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- H. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.7 PLACING CONCRETE FOR PEDESTRIAN PAVEMENT.

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.8 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.

3.9 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Walks: Light Sandblast Finish. Perform in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish.

Use an abrasive grit of the proper type and gradation to expose the aggregate and surrounding matrix surfaces to match the sample panel, as follows:

Light Cut: approximately 1/16" depth

- B. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
- C. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.

- D. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth and non-slip in conformance with ADA requirements.
- E. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
- F. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
- G. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.10 JOINTS - GENERAL

- A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.11 CONTRACTION JOINTS

- A. Unless otherwise indicated as sawcut on drawings, cut joints to depth as shown with a grooving tool or jointer of a radius as shown. Sawcut joints shall be sawn with a blade producing the required width and depth.
- B. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- C. Finish edges of all joints with an edging tool having the radius as shown, unless otherwise indicated as sawcut.
- D. Score pedestrian pavement with a standard grooving tool or jointer.

3.12 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Specified and shown joint material shall be placed with top edge 1/8" below the paved surface.
- D. Anchor with approved devices to prevent displacing during placing and finishing operations.
- E. Round the edges of joints with an edging tool with 1/8" maximum radius.
- F. Form expansion joints as follows:
 - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.

2. Using joint filler of the type, thickness, and width as shown.
3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.13 CONSTRUCTION JOINTS

- A. Locate longitudinal construction joints between slabs of vehicular pavement as shown.
- B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- C. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.
- D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb joint interval.

3.14 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.15 DAMPPROOFING

- A. Mop apply one heavy coat of asphalt dampproofing to soil side of retaining walls and plater walls from top of wall footing to minus 2 inches below finish grade.

3.16 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Resident Engineer.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.
- D. Liquid Membrane Curing:

1. For colored concrete, refer to CURING COMPOUNDS FOR COLORED CONCRETE above in PART 2- PRODUCTS. Apply as recommended by manufacturer.

3.17 CLEANING

- A. After completion of the curing period:
 1. Remove the curing material (other than liquid membrane).
 2. Sweep the concrete clean.
 3. After removal of all foreign matter from the joints, seal joints as herein specified.
 4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.18 PROTECTION

- A. The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Resident Engineer.

3.19 FINAL CLEAN-UP

- A. Remove all debris, rubbish and excess material from the Station.

--- E N D OF SECTION ---

**SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown on the Drawings. Construction shall include the following:
- B. Curb, gutter, and combination curb and gutter..

1.02 RELATED WORK

- A. Section 00 72 00, GENERAL CONDITIONS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Section 01 45 29, TESTING LABORATORY SERVICES.
- D. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- F. Section 31 20 00, EARTHWORK.

1.03 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.04 WEATHER LIMITATIONS

- A. Hot Weather: Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Contracting Officer's Representative.
- B. Cold Weather: Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Contracting Officer's Representative.

1.05 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the Contracting Officer's Representative, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture. Cost of the testing laboratory to be included in the Contractor's cost of project.

1.6 SUBMITTALS

Contractor shall submit the following.

- A. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Hot poured sealing compound

- 3. Reinforcement
- 4. Curing materials

- B. Concrete Mix Design.

- C. Concrete Test Reports

- D. Data and Test Reports: Select subbase material.
 - 1. Job-mix formula.
 - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - M147-65-UL Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)

 - M148-05-UL Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)

 - M171-05-UL Sheet Materials for Curing Concrete (ASTM C171)

 - M182-05-UL Burlap Cloth Made from Jute or Kenaf and Cotton Mats

- B. American Society for Testing and Materials (ASTM):
 - A82/A82M-07 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

 - A185/185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

 - A615/A615M-12 Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

 - A653/A653M-11 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

 - A706/A706M-09b Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

 - A767/A767M-09 Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement

 - A775/A775M-07b Standard Specification for Epoxy Coated Reinforcing Steel Bars

 - A820/A820M-11 Standard Specification for Steel Fibers for Fiber Reinforced Concrete

 - C31/C31M-10 Standard Practice for Making and Curing Concrete Test Specimens in the field

- C33/C33M-11a Standard Specification for Concrete Aggregates
 - C39/C39M-12 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - C94/C94M-12 Standard Specification for Ready Mixed Concrete
 - C143/C143M-10a Standard Test Method for Slump of Hydraulic Cement Concrete
 - C150/C150M-12 Standard Specification for Portland Cement
 - C171-07 Standard Specification for Sheet Materials for Curing Concrete
 - C172/C172M-10 Standard Practice for Sampling Freshly Mixed Concrete
 - C173/C173M-10b Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 - C192/C192M-07 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
 - C231/C231M-10 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 - C260/C260M-10a Standard Specification for Air Entraining Admixtures for Concrete
 - C309-11 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
 - C494/C494M-12 Standard Specification for Chemical Admixtures for Concrete
 - C618-12 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - C666/C666M-03(2008) . Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
 - D1751-04(2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
 - D4263-83(2012) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - D4397-10 Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
- C. American Welding Society (AWS):
- D1.4/D1.4M (2005) Structural Welding Code - Reinforcing Steel

PART 2 - PRODUCTS

2.01 GENERAL

- A. Concrete Type: Concrete shall be as per Table 1 – Concrete Type, air entrained.

TABLE I – CONCRETE TYPE

	Concrete Strength		Non-Air-Entrained	Air-Entrained	
	Min. 28 Day Comp. Str. Psi (MPa)	Min. Cement lbs/c. yd (kg/m ³)	Max. Water Cement Ratio	Min. Cement lbs/c. yd (kg/m ³)	Max. Water Cement Ratio
Type B	4000 (30) ^{1,3}	550 (325)	0.55	570 (340)	0.50
Type C	3000 (25) ^{1,3}	470 (280)	0.65	490 (290)	0.55
Type D	3000 (25) ^{1,2}	500 (300)	*	520 (310)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi (8.3 MPa) in excess of the compressed strength.
2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

B. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II – MAXIMUM SLUMP – INCHES (MM)

TYPE	MAXIMUM SLUMP*
Curb & Gutter	3 inches (75 mm)
Vehicular Pavement	2 inches (50 mm) (Machine Finished) 4 inches (100 mm) (Hand Finished)
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.03 SELECT SUBBASE

A. Subbase material shall consist of aggregate base in conformance with Section 26 of the Caltrans Standard Specifications.

2.04 FORMS

A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.

B. Do not use forms if they vary from a straight line more than 1/8 inch (3 mm) in any ten

foot (3000 mm) long section, in either a horizontal or vertical direction.

- C. Wood forms should be at least 2 inches (50 mm) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.05 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 1. Burlap having a weight of seven ounces (233 grams) or more per yard (square meter) when dry.
 2. Impervious Sheeting conforming to ASTM C171.
 3. Liquid Membrane Curing Compound conforming to ASTM C309, Type 1 and shall be free of paraffin or petroleum.

2.06 EXPANSION JOINT FILLERS

Material shall conform to ASTM D1751-04.

PART 3 - EXECUTION

3.01 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTHWORK.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.02 SELECT SUBBASE

- A. Mixing: Proportion the select subbase in conformance with section 26 of the Caltrans Standard Specifications.
- B. Placing:
 1. Place the aggregate base on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 8 inches (200 mm), and that when compacted, will produce a layer of the designated thickness.
 2. When the designated compacted thickness exceeds 6 inches (150 mm), place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
 3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
 4. If the elevation of the top layer is 1/2 inch (13 mm) or more below the grade, excavate the top layer and replace with new material to a depth of at least 3 inches (75 mm) in compacted thickness.
- C. Compaction:
 1. Perform compaction with approved hand or mechanical equipment well suited to the material being compacted.
 2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
 3. Compact each layer to at least 95 percent of maximum density as specified in Section 31 20 00, EARTHWORK.

- D. Smoothness Test and Thickness Control: Test the completed subbase for grade and cross section with a straight edge.
 - 1. The surface of each layer shall not show any deviations in excess of 3/8 inch (10 mm).
 - 2. The completed thickness shall be within 1/2 inch (13 mm) of the thickness as shown on the Drawings.
- E. Protection:
 - 1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
 - 2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the Government.

3.03 SETTING FORMS

- A. Base Support:
 - 1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
 - 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.
- B. Form Setting:
 - 1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
 - 2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
 - 3. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch (3 mm) when checked with a straightedge and shall not deviate from true line by more than 1/4 inch (6 mm) at any point.
 - 4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
 - 5. Clean and oil forms each time they are used.
 - 6. Make necessary corrections to forms immediately before placing concrete.
 - 7. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.
- C. The Contractor's Registered Professional Land Surveyor, specified in Section 00 72 00, GENERAL CONDITIONS, shall establish the control, alignment and the grade elevations of the forms or concrete slipforming machine operations. Staking notes shall be submitted for approval to the Contracting Officer's Representative prior to placement of concrete. If discrepancies exist between the field conditions and the Drawings, Contractor shall notify Contracting Officer's Representative immediately. No placement of concrete shall occur if a discrepancy greater than 1 inch (25 mm) is discovered.

3.04 EQUIPMENT

- A. The Contracting Officer's Representative shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.05 PLACING CONCRETE - GENERAL

- A. Obtain approval of the Contracting Officer's Representative before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.
- H. Cracked or Chipped Concrete Surfaces and Bird Baths. Cracked or chipped concrete and bird baths will not be allowed. Concrete with cracks or chips and bird baths will be removed and replaced to the nearest joints, and as approved by the Contracting Officer's Representative, by the Contractor with no additional cost to the Government.

3.06 PLACING CONCRETE FOR CURB AND GUTTER

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.07 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.
- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.

- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Resident Engineer.

3.08 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.

3.09 CONCRETE FINISHING CURB AND GUTTER

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/4 inch (6 mm) or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 1/8 inch (3 mm) for gutter and 1/4 (6 mm) for top and face of curb, when tested with a 10 foot (3000 mm) straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain. See Article 3.5, Paragraph H, above.
- H. Visible surfaces and edges of finished curb, gutter, and/or combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.10 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

- A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet (3000 mm) long and 6 inches (150 mm) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.
- B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 5 feet (1500 mm) in length, and straightedges, 10 feet (3000 mm) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.
- C. Test the surface for trueness with a 10 foot (3000 mm) straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.

- D. The finished surface of the pavement shall not vary more than 1/4 inch (6 mm) in both longitudinal and transverse directions when tested with a 10 foot (3000 mm) straightedge.
- E. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).
- F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 18 inches (450 mm) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 1/8 inch (3 mm) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.
- G. The finish surfaces of new and existing abutting pavements shall be flush and in alignment at their juncture.

3.11 JOINTS - GENERAL

- A. Place joints, where shown on the Shop Drawings and Drawings, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.12 CONTRACTION JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.
- B. Construct joints in curbs and gutters by inserting 1/8 inch (3 mm) steel plates conforming to the cross sections of the curb and gutter.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

3.13 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
 - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
 - 2. Using joint filler of the type, thickness, and width as shown.
 - 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.14 CONSTRUCTION JOINTS

- A. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- B. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.
- C. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

3.15 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.16 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Contracting Officer's Representative.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 4 mils (0.1 mm) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 12 inches (300 mm). Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon (5 m²/L) for both coats.
 - 2. Do not allow the concrete to dry before the application of the membrane.
 - 3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
 - 4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.17 CLEANING

- A. After completion of the curing period:
 - 1. Remove the curing material (other than liquid membrane).
 - 2. Sweep the concrete clean.

3. After removal of all foreign matter from the joints, seal joints as specified.
4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.18 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Contracting Officer's Representative, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Contracting Officer's Representative.

3.19 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

--- END OF SECTION---

**SECTION 32 12 16
ASPHALT PAVING**

PART 1 - GENERAL

1.01 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.02 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.
- C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

1.03 INSPECTION OF PLANT AND EQUIPMENT

The Contracting Officer's Representative shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.04 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.05 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
 - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
 - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
 - 3. Job-mix formula.
- C. Certifications:
 - 1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
 - 2. Asphalt cement certificate of conformance to State Highway Department requirements.
 - 3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of the Caltrans Standard Specifications.

- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Aggregate base and asphalt concrete materials shall conform to the requirements of the latest version of the Caltrans Standard Specifications, sections 26 and 39.. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA Contracting Officer's Representative.

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. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate maximum size:
 - 1. Base course over 152mm(6") thick: 38mm(1-1/2");
 - 2. Other base courses: 19mm(3/4").
- D. Aggregates for asphaltic concrete paving: Provide in conformance with Section 39 of the Caltrans Standard Specifications.

2.03 ASPHALTS

- A. Comply with provisions of Asphalt Institute Specification SS2:
 - 1. Liquid Asphalt: PG 64-10 or 64-16 per Section 93 of the Caltrans Standard Specifications.
 - 2. Tack coat: Uniformly emulsified, grade SS-1H, per section 94 of the Caltrans Standard Specifications.

2.04 SEALER

- A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.
- B. Where conflicts arise between this specification and the requirements in the latest version of the Caltrans Standard Specifications, the Caltrans Standard Specifications shall control.

PART 3 - EXECUTION

3.01 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the Caltrans Standard Specifications for the type of material specified.

3.02 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
 - 1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160

- degrees C(320 degrees F) maximum.
2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.03 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Contracting Officer's Representative or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Base
 1. Spread and compact to the thickness shown on the drawings.
 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- D. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.05 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. Remove all loose materials from the compacted base.
- B. Apply the specified tack coat where required, and allow to dry in accordance with the manufacturer's recommendations.
- C. 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 130 degrees C(280 degrees F).
 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.
- D. Spreading:
 1. Spread material in a manner that requires the least handling.
 2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.
- E. 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. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.06 APPLICATION OF SEAL COAT

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- B. Apply one coat of the specified sealer.
- 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

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.

3.08 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

--- END OF SECTION---

SECTION 32 14 13

CONCRETE PAVERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work includes layout and installation of concrete paver pavement, concrete truncated dome paver pavement, base materials, concrete grade beam and Paver Grate as shown and specified.

1.2 RELATED WORK

- A. Section 31 20 00, Earthwork Moving
- B. Section 32 05 20 Cement and Concrete for Landscaping

1.3 REFERENCES:

- A. International Concrete Pavement Institute (ICPI) requirements and recommendations.
- B. American Society of Testing Materials (ASTM).
 - 1. C 33, Specification for Concrete Aggregates.
 - 2. C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 3. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
 - 4. C 936, Standard Specification for Solid Interlocking Concrete Pavers.
 - 5. C 979, Specification for Pigments for Integrally Colored Concrete.
 - 6. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
 - 7. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
 - 8. D 1883, Test Method for California Bearing Ratio of Laboratory-Compacted Soils.

1.4 QUALITY ASSURANCE:

- A. Installer Qualifications: Engage an experienced installer who has successfully completed pavement installations similar in design, material, and extent indicated for this Project.
- B. Single-source Responsibility: Obtain each color, type, and variety of pavers, materials from single sources with resources to provide products and materials of consistent quality, appearance and physical properties without delaying progress of the Work.
- C. Field-constructed Mock-up:

1. Mockup: Construct a 5'-0" x 5'-0" sample area at job site and vibrate in place including any trim pavers and/or bands through the paver field. Protect sample panel until unit paving work is accepted. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 SUBMITTALS

- A. In addition to manufacturer's standard product data for each manufactured product, submit the following:
 1. two sets paver samples with manufacturer's product catalog sheets indicating full range of color, texture and thickness to be expected in completed work.
 2. Sieve analysis of aggregates for base and bedding materials per ASTM C 136.
 3. Construct field mockup as noted in Quality Assurance.

1.6 CODE REQUIREMENTS:

- A. Conform to the requirements of all applicable local, state and federal building and safety codes, ordinances and regulations.

1.7 PRODUCT HANDLING:

- A. Deliver and unload pavers at job site on pallets and bound in such a manner that no damage occurs to the product during hauling, handling or unloading at the job site.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS:

- A. Pavers: Minimum compressive strength of 4,000 psi in accordance with testing procedures ASTM C936.
- B. Materials used to manufacture interlocking concrete paving pavers conform to the following:
 1. Cement: Type III cement, ASTM C150 (Portland Cement)
 2. Aggregates: ASTM C33 (washed, graded sand and rock; no expanded shale or lightweight aggregates).
- C. Concrete Unit Pavers Type 1 shall conform to the following specifications:
 1. 3" x 24" x 4" Narrow Modular Concrete Paver.
 2. Color: Porcelain
 3. Finish: Light Sandblast
 4. Available from Stepstone Paver (800) 572-9029, or approved equal.

2.2 BASE MATERIALS:

- A. AGGREGATE BASE - CLASS II: Aggregate base shall be Class 2 crushed rock, and free from vegetable matter or other deleterious substances. The percentage composition by weight of aggregate base shall conform to Section 26 of the Caltrans Standard Specifications.

2.3 CONCRETE GRADE BEAM & CONCRETE SUB-SLAB: See Drawings.

2.4 STAIN AND EFFLORESCENCE REMOVERS:

- A. Refer to ICPI Tech Spec 5 Cleaning and Sealing Interlocking Concrete Pavement-a Maintenance and Protection Guide available at www.icpi.org . Another source is Removal of Stains From Concrete Surfaces available at www.nrc.ca/irc/cbd, publication CBD-153

2.5 WATERBASE SEALER

- A. Shall be a Teflon-based or Epoxy-modified sealer as recommended by the paver manufacturer.

2.6 MORTAR BED: Latex-Portland Cement Mortar.

2.7 SAND LAYING COURSE:

- A. Sand laying course shall conform to ASTM C33 as follows:

<u>Sieve Size</u>	<u>3/8 in.</u>	<u>No. 4</u>	<u>No. 8</u>	<u>No. 16</u>	<u>No. 30</u>	<u>No. 50</u>	<u>No. 100</u>
% passing	100	95-100	80-100	1-12	25-60	10-30	2-10

- B. CALTRANS Department of Transportation Specifications 90-3.03, Fine Aggregate Gradings:
 1. Thickness of sand laying course nominal 1" and uniform to ensure an even surface.
 2. The sand laying course shall be the responsibility of the paver installer.

2.8 SAND JOINT FILLER: Plaster sand.

PART 3 - EXECUTION

3.1 SUBGRADE PREPERATION:

- A. Subgrade is that area on which pavement, surfacing, base, sub-base or layer of any other material that may be specified, is to be placed.
- B. After clearing subgrade of all vegetation and debris in accordance with Section 16 of the Caltrans Standard Specifications, prepare the soil subgrade in accordance with the recommendations provided in the geotechnical report for concrete flatwork. Remove all boulders, hardened material or rock encountered. The earth shall be uniform for the full depth and width of the subgrade.
- C. The finished subgrade, immediately prior to placing subsequent material thereon, shall be in accordance with the Caltrans Standard Specifications for Class II Aggregate Base.

3.2 AGGREGATE BASE

- A. Deliver to site as a uniform mixture and spread each layer in one operation without segregation.
- B. Spread and compacted Class II Aggregate Base to a minimum of 95% relative compaction with equipment that will provide a uniform layer conforming to the planned section, and as specified in Section 26 of the Standard Specifications.
- C. The elevation of the compacted surface shall not deviate more than $\pm\frac{1}{2}$ inch over a 10 foot straightedge.

3.3 PAVER INSTALLATION

- A. Install per Manufacturer's recommendation.
- B. Before installing, clean pavers of all foreign material. Remove any cement residue off pavers prior to installation. Do not begin installation of pavers until subgrade and base have been prepared per Specifications.
- C. Screed sand bedding course to recommended depth. Sand is to remain undisturbed prior to the installation of unit pavers. Maintain constant sand moisture content.
- D. Start installation from a corner or straight edge, unless detailed otherwise, and proceed forward over the undisturbed sand bedding course. Proceed forward over the undisturbed sand laying course with pavers as shown on Drawings. Cut pavers to conform to edges without gaps. Cut pavers to avoid thin slices. Cut pavers with a masonry saw, clean and uniform. Align paver bands to conform with plans.
- E. Install pavers plumb and true to line and grade; to coincide and align with adjacent work and elevations in accordance with ICPI recommendations. Use string lines to hold pattern lines true. Maximum vertical deflection shall not exceed $\frac{3}{8}$ inch under a 10 foot straightedge. All perimeter edges shall be retained to secure the unit pavers and sand bedding course. Provide retainer as required. No unit paver joint shall be greater than $\frac{1}{4}$ " inch. No perimeter edge joint should be greater than $\frac{3}{8}$ ".
- F. Cut unit pavers with a double bladed stone cutter or diamond blade masonry saw.
- G. Use a plate vibrator to compact the pavers and to vibrate the sand up into the joints between the pavers. A plate type vibrating compactor capable of 3,000 to 5,000 lbs. centrifugal compaction force should be used to compact the unit pavers into the sand bedding course. 2 - 3 passes is recommended to insure an even elevation. Ensure paver surface is clear of debris prior to compaction. Do not use joint sand during this process. Avoid scuffing finished surface of pavers. Replace Scuffed pavers as directed by Owner's Representative.
- H. Profiled Pavers shall be protected from scuffing during compaction using a woven geotextile such as Mirafi 500X or other method. Scuffed pavers shall be replaced as directed by Owner's Representative.
- I. Spread plaster sand over the installed and approved pavers and vibrate into the joints between the pavers. Make several passes with the plate compactor, while sweeping the sand into the paver joints. Insure all joints are full before clean up. Excess sand should be swept up and removed from the completed unit paver installation.

- J. The completed paver installation shall be swept and washed down to provide a clean, finished, workmanlike hardscape pavement.
- K. The final surface elevation of pavers shall not deviate more than 3/8 in. under a 10 ft long straightedge.
- L. The surface elevation of pavers shall be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.
- M. Prior to applying Water-based Paver Sealer, remove any stains and efflorescence using cleaners specified in Part 2 of this specification. Apply Water-based Paver Sealer, per ICPI Tech Spec 5 and label instructions, after final cleanup and wash down of paving stone surface. During application, protect surrounding areas from over spray. All traffic, pedestrian or vehicular, shall be kept off of sealed pavers until initial cure time has been achieved.

3.4 FIELD QUALITY CONTROL:

- A. After sweeping the surface clean, check final elevations for conformance to the drawings.
- B. Lippage: No greater than 1/8 inch difference in height between adjacent pavers.
- C. The minimum slope of the finished pavement surface shall be 1%.

3.5 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with Contractor's Waste Management Plan and Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the Contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

3.6 CLEAN-UP

- A. Perform the work under this Section so as to keep affected portions of the site neat, clean and orderly. Upon completion of the work under this Section, remove immediately all surplus materials, rubbish and equipment associated with or used in the performance of this work.
- B. Wash and clean the completed paver installation to provide a clean, finished, workmanlike installation.
- C. Reset all disturbed pavers and brush joints with bedding material.
- D. Protect the work from damage and sediment from construction activity on the site.

--- END OF SECTION---

**SECTION 32 17 23
PAVEMENT MARKINGS**

PART 1 - GENERAL

1.01 DESCRIPTION

This work shall consist of furnishing and applying paint and reflective glass beads on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Contracting Officer's Representative. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

1.02 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.
- B. Paint.
- C. Reflective Glass Beads

1.03 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - TT-B-1325CBeads (Glass Spheres); Retro-Reflective
 - TT-P-1952DPaint, Traffic Black, and Airfield Marking, Waterborne
- C. Master Painters Institute (MPI):
 - Approved Product List - 2010

PART 2 - PRODUCTS

2.01 PAINT

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952D. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

2.02 REFLECTIVE GLASS BEADS

Beads shall conform to Fed. Spec. TT-B-1325C, Type I, Gradation A. When used in regions of high humidity, coat beads with silicone or other suitable waterproofing material to assure free flow. Furnish the glass beads in containers suitable for handling and strong enough to prevent loss during shipment. A certificate shall accompany each batch of beads stating compliance with this section.

2.03 PAINT APPLICATOR

Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. If the equipment does not have a glass bead dispenser, use a separate piece of equipment. Adjust and synchronize the equipment with the paint applicator so that the reflective beads are distributed uniformly on the paint lines within ten seconds without any waste. An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

2.04 SANDBLASTING EQUIPMENT

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m³/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Contracting Officer's Representative. The application of paint conforming to Fed. Spec. TT-P-1952D is an option to removal of existing paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Contracting Officer's Representative has inspected the surface and gives permission to proceed. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

3.02 APPLICATION

Apply uniformly painted and reflective pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Disperse reflective glass beads evenly on the wet paint at a rate of 720 g/L (6 pounds per

gallon) of paint. Apply paint in one coat. At the direction of the Contracting Officer's Representative, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, faulty distribution of beads, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

3.03 PROTECTION

Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

3.04 DETAIL PAVEMENT MARKING

Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Show the International Handicapped Symbol at indicated parking spaces. Color shall be as shown. Apply paint for the symbol using a suitable template that will provide a pavement marking with true, sharp edges and ends. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

3.05 TEMPORARY PAVEMENT MARKING

When shown or directed by the Contracting Officer's Representative, apply Temporary Pavement Markings of the color(s), width(s) and length(s) shown or directed. After the temporary marking has served its purpose and when so ordered by the Contracting Officer's Representative, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that the surface to which the marking was applied will not be damaged. As an option, an approved preformed pressure sensitive, reflective, adhesive tape type of temporary pavement marking of the required color(s), width(s) and length(s) may be furnished and used in lieu of temporary painted and reflective marking. The Contractor shall be fully responsible for the continued durability and effectiveness of such marking during the period for which its use is required. Remove any unsatisfactory tape type marking and replace with painted and reflective markings at no additional cost to the Government.

3.06 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Medical Center.

--- END OF SECTION---

SECTION 32 84 00
PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies materials and procedures for furnishing and installing a complete automatically-controlled irrigation system, including piping, valves, fittings, control wiring, electrical connections, drip emitter tubing, bubblers, and all other necessary accessories.
- B. Design intent is to connect the new system shown with the existing Controller A servicing this area.

1.2 RELATED WORK

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT
- C. Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS
- D. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Division 26, ELECTRICAL: Power connection to controller
- F. Section 31 20 00, EARTHWORK
- G. Section 32 90 00, PLANTING

1.3 ABBREVIATIONS

- A. FPT: Female pipe thread
- B. HDPE: high-density polyethylene plastic
- C. PVC: Polyvinyl chloride plastic
- D. PE: Polyethylene
- E. O.D.: Outside diameter
- F. I.D.: Inside diameter
- G. GPH: Gallons per hour
- H. GPM: Gallons per minute
- I. IPS: Iron pipe size

1.4 REFERENCE, CODES AND STANDARDS

- A. All current International Building Code, state, local, federal, and VA codes, standards, regulations, and ADA requirements shall pertain to this project. These may include but not limited to, architectural, structural, mechanical, electrical, fire and life safety codes. The project shall follow the most stringent and current rules codes, standards, and regulations.
 - 1. AB1881 State of California Model Water Efficient Landscape Ordinance, California Code of Regulation

2. Water Use Classification of Landscape Species (WUCOLS)
3. America Society of Irrigation Consultant (ASIC) Design Guidelines
4. California Landscape Standards, California Landscape Contractors Association (CLCA), Sacramento, California
5. CAL-OSHA, Title 8, Subchapter 4-Construction Safety Orders, and Subchapter 7-General Industry Safety Orders
6. NFPA 70, National Electrical Code (NEC)
7. California Electrical Code
8. Uniform Plumbing Code (UPC)
9. California Plumbing Code (CPC)
10. National Fire Protection Association (NFPA) 24, Section 10.4 Depth of Cover
11. Underwriters Laboratories (UL): Electrical wiring, controls, motors and devices, UL listed and so labeled.
12. American Society of Testing Materials (ASTM)

1.5 APPLICABLE PUBLICATIONS

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

B. American Society Of Mechanical Engineers (ASME):

- B16.18-2012..... Cast Copper Alloy Solder Joint Pressure Fittings
- B16.22-2012..... Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- B16.24-2011..... Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500
- B18.2.1-2012..... Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

C. American Society For Testing And Materials (ASTM):

- A536-84 (R2009)..... Ductile Iron Castings
- B32-08..... Solder Metal
- B61-08..... Steam or Valve Bronze Castings
- B62-09..... Composition Bronze or Ounce Metal Castings
- B88/B88M-09 Seamless Copper Water Tube
- B813-10..... Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- D1785-12 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120

- D2241-09 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
- D2464-13 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings,
Schedule 80
- D2466-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- D2467-13 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D2564-12 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping
Systems
- D2609-02(2008) Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
- D2683-10 Socket-Type Polyethylene Fittings for Outside Diameter-
Controlled Polyethylene Pipe and Tubing
- D2855-96(2010) Making Solvent Cemented Joints with Poly (Vinyl Chloride)
(PVC) Pipe and Fittings
- D3261-12 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for
Polyethylene (PE) Plastic Pipe and Tubing
- F477-10 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F656-10 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride)
(PVC) Plastic Pipe and Fittings
- F771-99(2005) Polyethylene (PE) Thermoplastic High-Pressure Irrigation
Pipeline Systems
- D.American Water Works Association (AWWA):
 - C500-09 Metal-Seated Gate Valve for Water Supply Service
 - C504-10 Rubber-Seated Butterfly Valves
 - C906-07 Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm)
Through 63 in. (1600 mm), for Water Distribution and
Transmission
- E.American Welding Society (AWS):
 - A5.8/A5.8M:2011 Filler Metals for Brazing and Braze Welding
- F.Manufacturers Standardization Society (MSS):
 - SP-70-2011 Gray Iron Gate Valves, Flanged and Thread Ends

1.6 QUALITY ASSURANCE:

A. General Criteria:

1. The Contractor, personally or through an authorized representative, shall supervise the work constantly, and shall keep the same foreman and workers on the job from commencement to completion.

2. The Contractor should be an employer of workers that include a landscaping contractor licensed by the State of California and a certified irrigation contractor (CIC) qualified by The Irrigation Association. Contractor shall have a minimum of five (5) years of experience in installing irrigation systems of a similar size.

B. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be cast integrally with equipment, or stamped, or otherwise permanently marked on each item of equipment.

C. System Requirements:

1. Full and complete coverage is required. The Contractor shall, at no additional cost to the Government, make minor adjustments necessary to avoid plantings and obstructions such as signs, utilities and light standards to achieve full and complete coverage of irrigated areas without overspray on roadways, sidewalks, window wells, and buildings, and to protect trees from close high spray velocity.
2. Layout work as closely as possible to Drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown. Lines are to be common trenched whenever possible.
3. Locations of remote control valves are schematic. Remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads or back of sidewalk, or as shown.
4. The irrigation system shall be connected to the campus dedicated irrigation main line where shown and specified.
5. Contractor is responsible for installing all equipment indicated both on drawings and as recommended by the manufacturer for an operational and functioning drip system. This includes flushing end valves, check valves, and visual pop-up indicators.
6. All irrigation components shall be commercial grade and carry a 5 year warranty.
7. Completely program existing controller and satellites according to approved irrigation schedule. Contractor shall make continuous adjustments to the programming as required from irrigation installation completion to the end of the Maintenance Period, to provide adequate watering of new plant materials. Plants shall not be overwatered, resulting in plant health issues or drainage issues. Bring any irrigation issues immediately to the attention of the Contracting Officer's Representative.

8. Manufacturer of Control Systems to certify Control System is complete, including all related components, and totally operational. Submit certificate to Contracting Officer's Representative.

1.7 SUBMITTALS

A. Qualification Data

1. Provide qualification data, including contractor license and certificate by Irrigation Association, and a list of three (3) projects of similar size and three (3) references.

B. Material List

1. Submit product data as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLE. Include each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete material list shall be submitted prior to performing any work.
2. Equipment or materials installed or furnished without prior approval of the Contracting Officer's Representative may be rejected and the Contractor required to remove such materials from the site at Contractor's own expense.

C. As-Built Drawings

1. The Contractor shall provide as-built drawings.
2. The original "as-built" plan shall be submitted to the Contracting Officer's Representative for approval prior to preparing the final As-Built prints, PDF and CAD files, and producing Controller Chart. See 1.7D for Controller Chart.
3. Drawings shall include depth, if applicable, and dimensions from two permanent points of reference, building corners, sidewalk, or road intersections, providing the location of the following items:
 - a. Connection to existing water lines
 - b. Connection to existing electrical power
 - c. Relocated existing equipment
 - d. Gate valves
 - e. Routing of pressure lines (dimension maximum 100 feet (30m) along routing)
 - f. Control valves
 - g. Routing of control wiring (dimension maximum 100 feet (30m) along routing)
 - h. Quick coupling valves
 - i. Controller location
 - j. Other related equipment as directed by the Contracting Officer's Representative

4. Identify all valves as to size, station, number and type of irrigation. All changes made during construction shall be shown in color red. Label plans "AS-BUILT" with date and the General Contractor's and Landscape Contractor's name, address and phone number.
5. Submit the approved As-Built drawings as a hard copy at original scale, an electronic PDF file, and an electronic CAD file in conformance with the VA CAD Standards. Deliver the above items to the Contracting Officer's Representative prior to final inspection.
6. All costs associated with this work will be included in the Contract prices paid for the various items of work and no additional compensation will be allowed therefore.

D. Controller Chart

1. Provide one laminated controller chart showing the area covered by controller for each automatic controller supplied at the maximum size controller door will allow. Chart shall be a reduced drawing of the actual "as-built" system. If controller sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside the controller door.
2. Controller chart shall be a blackline print with a different color used to show area of coverage for each station. Charts must be completed and approved by the Contracting Officer's Representative prior to final inspection of the irrigation system.

E. Maintenance and Operating Instructions and Manuals

1. Contractor shall prepare an Operation and Maintenance Manual, organized in a 3-ring binder, containing the following information.
 - a. Contractor's name, address, and telephone number
 - b. Duration of guarantee, periods as specified herein
 - c. List of equipment with names and addresses of local manufacturer's representatives with duration of written warranties
 - d. Complete operating and maintenance instructions on all equipment
 - e. Spare parts lists and related manufacturer's information
2. Submit two (2) copies of the Operation and Maintenance Manual to the Contracting Officer's Representative within 10 Calendar Days of completion of work of this Section and as a condition of project acceptance.
3. In addition to the above-mentioned maintenance manuals, provide the Government's maintenance personnel with training at the jobsite to provide instructions for major components. Training shall be conducted to the satisfaction of the Contracting Officer's Representative. Contractor shall be required to repeat the training at his own expense until the Contracting Officer's Representative has concluded that the training has been conducted satisfactorily.

1.8 SPARE PARTS / EXTRA MATERIALS

- A. Furnish spare parts / extra materials, as listed below, that match products installed. The extra materials shall be packaged with protective covering for storage and identified with labels describing contents.
 - 1. Bubblers: Provide two (2) for each type and size installed for the project.
 - 2. Drip system emitter tubing and dripline tubing: Provide 50 feet (15 m) of each tubing size installed for the project.
 - 3. Two (2) sets of special tools required for removing, disassembling and adjusting each type of valve installed for the project.
 - 4. Two (2) - 5 foot valve keys for operation of gates valves.
 - 5. Two (2) quick coupler keys and matching hose swivels for every type of quick coupling valve installed.
- B. The above-mentioned equipment shall be delivered to the Government at the conclusion of the project. Before final inspection can occur, evidence that the Government has received the spare parts / extra materials must be shown to the Contracting Officer's Representative.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support pipe to prevent sagging and bending.
- C. Any section of pipe that has been dented or damaged will be discarded and, if installed, be replaced with new piping.

1.10 WARRANTY

- A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting there from within a period of one (1) year from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. If dissimilar metal materials are used in the piping system, use the appropriate dielectric union to isolate the metals.
- C. Hard Copper Tube: ASTM B88, Type L (ASTM B88, Type B) water tube, drawn temper
 - 1. Copper pressure fittings: ASME B16.22, wrought-copper solder-joint fittings

2. Bronze flanges: ASME B16.24, Class 150, with solder-joint end
 3. Copper unions: Cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends
- D.HDPE pressure pipe: AWWA C906, with a minimum DR of 11 and PE compound number required to give pressure rating not less than 200 psi (1380 kPa)
1. PE butt, heat-fusion fittings shall be ASTM D3261.
 2. PE socket-type fittings shall be ASTM D2683.
 3. All fittings shall be the same DR rating as the pipe.
- E.PVC pipe: Use only new, non-corroded, defect free materials of brands and types that meet the specified standards specified herein, or approved equals.
1. Irrigation Main:
 - a. 4 inches(101.6 mm) and larger: Polyvinyl Chloride (PVC) Pressure Pipe, Gasketed Class 200, PVC 1120, Pipe shall be made from NSF-approved Type I, Grade PVC compound conforming to ASTM Specification D 2241
 - b. 3 inches (76.2 mm) and smaller: Polyvinyl Chloride (PVC) Pressure Pipe, 1120 - Schedule 40 PVC compound conforming to ASTM Specification D 1785
 2. Irrigation Laterals: Polyvinyl Chloride, ASTM D2241, PVC 1120, Schedule 40
 3. Threaded Pipe: Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints
 4. All PVC pipes shall bear the following markings:
 - a. Manufacturer's name
 - b. Nominal pipe size
 - c. Schedule of class
 - d. Pressure rating in psi
 - e. NSF (National Sanitation Foundation) approval
 - f. Date of extrusion
- F. Fittings:
1. Irrigation Mains (4 inches (101.6 mm) and larger): Ductile iron fittings: Fittings shall be manufactured with ductile iron, Grade 65-45-12 in accordance with ASTM A-536. Fittings shall have deep bell push-on joints with gaskets meeting ASTM F-477. Fittings shall be IPS size and pressure rated at 350 psi.
 2. Irrigation Mains (3 inches (76.2 mm) and smaller): Schedule 40, solvent welded socket type, ASTM D2466.
 3. Irrigation Laterals: PVC, Schedule 40, solvent welded socket type, ASTM D2466.
 4. Threaded Pipe: Schedule 80, ASTM D2464

5. Swing Joints: Threaded fittings with elastomeric seals that allow 360-degree rotation, and designed for minimum 200 psi (1380 kPa) working pressure, may be used in lieu of standard threaded fittings.

2.2 PIPE JOINING MATERIALS

- A. Bolts and nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- B. Brazing filler metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- C. Solder filler metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- D. Solvent cements for joining PVC piping: ASTM D2564. Include primer according to ASTM F656.
- E. Plastic fittings: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 VALVES

- A. Underground Manual Shut-Off Valves:
 1. Gate valves (3 inches (75 mm) and smaller): Bronze body, Screw-in Bonnet, Threaded with Cross Handle non-rising stem turning clockwise to close, 200 psi (1380 kPa) minimum working pressure.
 2. Operations:
 - a. Underground: furnish valves with square or T-Handle (depending on size) socket wrench for operation.
 - b. Ends of valves shall accommodate the type of pipe installed.
- B. Check Valves: Swing or spring. High impact PVC Type II body and bonnet, with minimum working pressure of 235 psi (1620 kPa)
- C. Pressure Reducing Valve: Bronze body with stainless steel strainer and union
- D. Ball Valves (2 inch (50 mm) and smaller): Full-port ball valves with Schedule 80 PVC body, O-Ring under seat, and 90 degree on/off handle. Ball valves to have union NPT female end connections.
- E. Remote Control Valves:
 1. Valves shall be globe type of heavy duty construction and shall have manual shut-off and flow control adjustment and provide for manual operation.
 2. Cast iron body with brass bonnet, trim and renewable seat and have two inlet taps (furnish with one inlet tap plugged) to allow installation as either a straight or angle pattern valve.
 - a. Install valves with unions on each side to allow for easy removal.
 - b. Valves shall have a minimum of 150 psi (1035 kPa) working pressure.
 - c. Each valve shall be in a valve box.

3. Valves to operate at no more than 7 psi (50 kPa) pressure loss at manufacturers maximum recommended flow rate.
4. Valves shall be completely serviceable from the top without removing valve body from the system.

2.4 VALVE BOXES

A. General Dimensions per valve type:

1. Gate Valve and Quick Coupler: 10 inches(250 mm), Round
2. Master Valve: 14 inches (350mm)W x 19 inches(475 mm)L x 12 inches (300 mm)D, Rectangular shaped.
3. Flow Sensor: 14 inches (350mm)W x 19 inches(475 mm)L x 12 inches (300 mm)D, Rectangular shaped.
4. Remote Control Valve: 14 inches (350mm)W x 19 inches(475 mm)L x 12 inches (300 mm)D, Rectangular shaped.
5. Remote Control Valve (Drip): 20 inches (500 mm)W x 26 inches (620 mm)L x 12 inches (300 mm)D, Rectangular shaped.
6. Drip components: Top diameter to be 6 inches (150 mm) minimum, height of box to be 10-1/4 inches (260 mm).

B. Gate valve and quick coupler valve boxes shall be round made of reinforced plastic with a lid constructed from HDPE, color: black. Box dimension shall be adapted to depth of cover required over pipe at valve location. Box shall have a bolt down lid.

C. Set box cover flush with finish grade

1. Label boxes by heat branding "GV" for gate valve or "QC" for quick coupler, into the lid. Size of letters shall be a minimum of 2 inches (50 mm). Letters shall be located at center of valve cover and shall face nearest main road or service road.

D. Remote control valve boxes shall be HDPE structural foam Type A, Class III, color: black. Box shall have a bolt down lid.

1. Set box cover flush with finish grade
2. Label boxes by heat branding the designated controller and circuit number into the lid. Size of numbers shall be a minimum two (2) inches (50 mm). Numbers shall be located at center of valve cover and shall face nearest main road or service road.

E. Drip zone components: Round reinforced plastic valve box and lid constructed from HDPE, color: black. Lid shall have lift-hole for opening. Box shall have a bolt down lid.

F. All valve boxes in pavement shall be precast concrete with a cast iron lid. Compressive concrete strength shall be in excess of 4000 psi (30 MPa). Box shall have a bolt down lid.

G. Provide tampered proof bolts for all lids.

2.5 BUBBLERS

- A. Bubblers shall be of the pressure compensating, permanently assemble type with 1/2 inch (12 mm) FPT inlet.

2.6 DRIP SYSTEMS

A. Dripline (In Line Drip) Tubing:

1. Dripline tubing shall be made of UV resistant material with impregnated emitters. Tubing shall be linear low-density 5/8 inch (16 mm or 17 mm) polyethylene with a minimum wall thickness of 0.045 inch (0.1 mm).
2. Emitter shall have dual discharge ports on opposing sides of the tubing.
3. The tubing shall have the emitters spaced every 18 inches (450 mm), and flow rate of 1.0 GPH.
4. The emitters shall be continuously self-flushing and pressure-compensating.
5. The dripline tubing row spacing shall be 18 inches on center.
6. The dripline tubing with emitters shall be manufactured with root intrusion technology.

- A. Drip Accessories: Provide a dripline flush valve, air relief valve and operation indicator as required and detailed. Accessories shall be manufactured by the same manufacturer as the dripline tubing.

2.7 QUICK COUPLERS

- A. Quick couplers shall be 1" and have all parts contained in a two-piece unit and shall consist of a coupler water seal valve assembly and a removable upper body to allow the spring and key track to be serviced without shut down of the main.

B. Metal parts shall be brass.

C. Lids shall be lockable vinyl covered and have springs for positive closure on key removal. Also see 2.4 VALVE BOXES of this Section.

2.8 LOW VOLTAGE CONTROL VALVE WIRE

- A. Wire shall be solid copper wire, Underwriters Laboratories Inc. approved for direct burial in ground.

B. Size of control wire shall be in accordance with manufacturer's recommendations, never less than No. 14.

C. Wire colors shall be as follows:

1. Common ground wire shall have white insulating jacket
2. Control wire shall have a red insulating jacket
3. Spare wires shall have a yellow insulating jacket
4. Master valve control wire shall have a blue insulating jacket
5. Flow sensor shall have one orange and one black insulating jacket

- D. Provide a separate ground wire for each controller. Where there is more than one controller, provide a different color control wire for each controller.
- E. Rain sensor wire shall be 18 gauge, 2-conductor direct burial wire. Wire run shall be no longer than 100 feet (30 m). Wire shall be black in color.

2.9 SPLICING MATERIALS:

- A. Splicing materials shall be epoxy waterproof sealing packet.

2.10 SLEEVE MATERIAL

- A. ASTM D2241, PVC Schedule 40
- B. White color pipe for water
- C. Grey color pipe for wires

2.11 WARNING TAPE

- A. Provide standard, 4-Mil polyethylene 3 inch (76 mm) wide tape, detectable type, blue with black letters, and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW" above all main lines.

2.12 TRACER WIRES

- A. Tracer Wires shall be No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with irrigation main lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine proposed irrigation areas for compliance with requirements and conditions affecting installation and performance.
- B. Set flags to identify locations of proposed irrigation system – main line routing and valves. Obtain approval of the layout by the Contracting Officer's Representative before excavation.

3.2 PIPE INSTALLATION - GENERAL

- A. Layout work as closely as possible to Drawings. Swing joints, offsets and all fittings are not shown. Lines are to be in a common trench wherever possible.
- B. Install irrigation lines to avoid underground utilities, such as, but not limited to: heating, ventilating, and air conditioning trenches; electric ducts; steam, condensate, chilled water, storm and sanitary sewer lines; and existing water and gas mains; all of which have the right of way.
- C. Existing sidewalks and curbs shall not be cut during trenching and installation of pipe. Install pipe under sidewalks and curbs by jacking, auger boring, or by tunneling. Repair or replace any cracked concrete, due to settling, during the warranty period.
- D. Do not lay pipe on unstable material, in wet trenches or, in the opinion of Contracting Officer's Representative, when trench or weather conditions are unsuitable for work.

- E. Allow a minimum of 4 inches (100 mm) between parallel pipes in the same trench.
- F. Clean the interior portion of pipe and fittings of foreign matter before installation. Securely close open ends of pipe and fittings with caps or plugs to protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- G. The full length of each section of pipe shall rest upon the pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipe on wood blocking.
- H. Hold pipe securely in place while joint is being made.
- I. Do not work over, or walk on, pipe in trenches until covered by layers of earth, well tamped, in place to a depth of 12 inches (300 mm) over pipe.
- J. Connect new system to existing mains or new point of connection as required.
 - 1. Coordinate capping, rerouting, and required modifications to adjacent existing irrigation systems prior to the start of demolition and excavation work.
 - 2. Ensure that existing irrigation systems adjacent to and beyond the project limits are and remain fully functional and protected from construction damage.
 - 3. Work includes, but not necessarily limited to, the following:
 - a. Protect the existing irrigation systems mainline water sources and install new mainline connections to provide and maintain water to existing plants served by the existing irrigation systems
 - b. Protect electrical low voltage wire connections from the existing irrigation controllers to remote control valves serving existing irrigation systems beyond the project limits and/or install new wires so that existing irrigation systems remain fully functional at all times
 - c. Test and repair existing irrigation systems as required and directed by the Contracting Officer's Representative.
- K. Remove existing irrigation equipment within the project limits as required and directed by the Contracting Officer's Representative. Minimum cover over water mains shall be 18 inches (450 mm). Cover laterals to minimum depth of 12 inches (300 mm).
- L. Warning tape shall be continuously placed 3 inches (75 mm) above irrigation system water mains.
- M. Backfill and Compacting
 - 1. Backfill excavations and trenches with clean soil, free of debris.
 - 2. Regardless of the type of pipe covered, compact to minimum 95% density under pavements and 85% under planted areas.
 - 3. Firmly compact soil around swing joints to minimize settling.
 - 4. Dress off areas to finish grades. Re-dress any areas that subsequently settle.

3.3 PLASTIC PIPE INSTALLATION

- A. Plastic pipe shall be snaked in trench at least 1 foot per 100 feet (1 meter to 100 meters) to allow for thermal construction and expansion and to reduce strain on connections.

B. Joints

1. Solvent Welded Socket Type: ASTM D2855
2. Threaded Type: Apply liquid teflon thread lubricant on threaded joints. After joint is made hand tight (hard), a strap wrench should be used to make up to two additional full turns.
3. Elastomeric Gasket: ASTM F477
 - a. Immediately before joining two lengths of PVC pipe, the inside of the bell or coupling, the outside of the spigot and the elastomeric gasket shall be thoroughly cleaned to remove all foreign material.
 - b. Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications
 - c. The spigot and bell shall be aligned and pushed until the reference line on the spigot is flush with the end of the bell or coupling. Pushing shall be done in a smooth, steady motion.
 - d. Concrete thrust blocks shall be installed where the irrigation main changes direction at "L" and "T" locations and where the irrigation main terminates.
 - 1) Concrete thrust blocks for supply mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all thrust created by the maximum internal water pressure.
 - 2) Pressure tests shall not be made for a period of 36 hours following the completion of pouring of the thrust blocks.

3.4 SLEEVE INSTALLATION

- A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Use grey color pipe for wires and white pipe for water lines.
- C. Sleeves to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 12 inches (300 mm) beyond edges of paving or construction.
- D. Bed sleeves with a minimum of 4 inches (100 mm) of sand backfill above top of pipe in areas where pipe is placed prior to hardscape is installed.

3.5 VALVE INSTALLATION

- A. Install valves where shown on Drawings and group together where practical. Limit one remote control valve per box.

- B. Locate valve boxes 12 inches (300 mm) from and perpendicular to walk edges, buildings, and walls. Provide 12 inches (300 mm) between valve boxes where valves are grouped together.
- C. Thoroughly flush main line before installing valves.
- D. Clean interior of valves of foreign matter before installation.
- E. Install valves in shrub or groundcover areas where possible.
- F. No valves shall be set under roads, pavement or walks. Label control line wire at each valve with a 2-1/4 inch by 2-3/4 inch polyurethane identification tag, indicated identification number of valve (controller and station number). Attach label to control wire.
- G. Place gopher wire mesh under the valve box and wrap up each side a minimum of 6 inches (150 mm). Wire mesh shall be 19 gauge galvanized steel with 1/2 inch (13 mm) mesh.
- H. Install 4 inch (100 mm) layer of pea gravel or 3/4 inch (20 mm) drain rock on top of the wire mesh at the bottom of the valve box.
- I. Set valve box cover flush with finished grade.
- J. Heat brand controller and station number or valve type (gate valve or quick coupler) into the valve box lid.

3.6 QUICK COUPLER INSTALLATION

- A. Quick couplers shall be placed on temporary nipples extending at least 3 inches (80 mm) above finished grade.
- B. Install quick couplers on swing joints, as detailed on Drawings.
- C. Flush all main and lateral lines prior to the installation of quick couplers.

3.7 DRIPLINE (IN LINE) TUBING INSTALLATION

- A. Thoroughly flush all lateral lines before installing dripline tubing.
- B. Install as per manufactures recommendations
- C. Install dripline tubing with impregnated emitters 2 to 4 inches (50 to 100 mm) below grade, staked down every four (4) feet and at every fitting. Cover with a minimum 2 inches (50 mm) of mulch.
- D. Install dripline in a grid pattern utilizing the specified spacing. Install per VA standard detail.
- E. Install air relief valves at all high points on the system.
- F. Install a minimum two (2) manual flush valves per zone at the low points and ends of the zone.
- G. Install a minimum two (2) operation indicators at the ends of the zone.
- H. Install pressure regulators and filter units in control valve boxes.
- I. Adaptation from PVC Schedule 40 fittings to drip tubing shall be line size by 3/4 inch (20 mm) hose thread.
- J. Tape all ends during installation and do not allow dirt or debris to enter tubing
- K. Use fittings at sharp bends and do not allow dripper line to kink
- L. Use manufacturer recommended fittings for all changes in direction.

3.8 CONTROL WIRE INSTALLATION

- A. Wiring from controller to valves and stub cuts for future extension shall be located in trench with new mains, unless cross-country route is shown. Locate in trench with mains when possible on cross-country routes.
- B. Wiring bundles located with piping shall be set under the shoulder of the pipe. Wires shall be bundled, and tied or taped at 15 foot (4.5 m) intervals. A numbered tag shall be provided at each end of a wire, i.e., at valve, at field located controllers. The wires at each end of wire to be the same in number and color. Do not tape wires located within sleeves.
- C. Splicing shall be held to a minimum. A pullbox shall be provided at each splice. No splices will be allowed between field located controllers and remote control valves.
- D. Provide 12 inch (300 mm) expansion loops in wiring at each wire connection or change in wire direction. Provide 24 inch (600 mm) loop at remote control valves.
- E. The power wire(s) for the operation of irrigation system shall not be run in same conduit as the irrigation control wire(s).

3.9 TRACER WIRE INSTALLATION

- A. Tracer wire shall follow main line pipe and branch lines and terminate in yard box with gate valve controlling these main irrigation lines. Provide sufficient length of wire to reach finish grade, bend back end of wire to make a loop and attach a plastic label with designation "Tracer Wire."
- B. Tracer wire shall be installed on bottom of trench, adjacent to vertical pipe projections, carefully installed to avoid stress from backfilling, and shall be continuous throughout length of pipe with spliced joints soldered and covered with insulation type tape.
- C. Record locations of tracer wires and their terminations on project record documents.

3.10 ADJUSTMENTS

- A. Adjust settings of controllers to provide adequate water to each irrigation zone.
- B. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to planting. Adjustments may include changes in nozzle sizes and degrees of arc as required.
- C. Adjust flow control of remote control valves to provide flow rate at rated operating pressure required for each irrigation circuit.

3.11 TESTING AND SITE OBSERVATION

- A. Coordinate scheduling testing / observations with the Contracting Officer's Representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Observations conducted by persons other than the Contracting Officer's Representative shall not be permitted without prior written authorization of the Contracting Officer's Representative.

C.No site observations will commence without as-built drawings. In the event the Contractor calls for a site visit without as-builts drawings, without completing previously noted corrections, or without preparing the system for said visit, he shall be responsible for reimbursing the Contracting Officer's Representative at his current bill rates per hour portal to portal (plus transportation costs) for inconvenience. No further site visits will be scheduled until this charge has been paid and received.

D.Contractor shall be responsible for notifying the Contracting Officer's Representative in advance for the following inspections/observation meetings, according to the time indicated:

1. Pressure supply line installation and testing-48 hours
2. Remote control valves (RCV) and lateral lines visual inspection – 48 hours
3. Coverage test-48 hours
4. Final inspection- 7 days

E. Tests and Inspections:

1. Pressure supply line installation and testing:
 - a. Make hydrostatic tests with risers capped when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure. Keep all couplings and fittings exposed
 - b. Apply the following tests after welded plastic pipe joints have cured for at least 24 hours.
 - 1) Ring-Tite Main Line:
 - i. Remove all the air from the piping system then test live (constant pressure) and quick coupler valve lines hydrostatically at 125 psi minimum. Lines will be approved if test pressure is maintained for six (6) hours. The lines shall be restored to the original test pressure and the amount of water required to do so shall be measured. Approved tables of allowable loss will be consulted, and the line will be approved or not approved as such results may indicate. The Contractor shall make tests and repairs as necessary until test conditions are met.
 - 2) Solvent Weld Main Line:
 - i. Remove all the air from the piping system then test live (constant pressure) and quick coupler valve lines hydrostatically at 125 psi minimum. Lines will be approved if test pressure is maintained for six (6) hours. The Contractor shall make tests and repairs as necessary until test conditions are met.
2. RCV and lateral lines visual inspection:
 - a. Test RCV controlled lateral lines with water at line pressure and visually inspect for leaks. Retest after correcting defects.

3. Coverage Test:
 - a. After electrical circuitry has been energized and final adjustment of the drip system have been complete, test each remote control valve with a visual coverage/wetting pattern test in the presence of the Contracting Officer's Representative, to determine if the water coverage for planting areas is complete and adequate. Furnish all material and perform all work required to correct any inadequacies of coverage due to deviation from Drawings. Contractor is responsible to perform all work required correcting any inadequate coverage at his own expense where the system has been willfully installed as indicated on the Drawings and the coverage is obviously inadequate, without bringing this to the attention of the Contracting Officer's Representative.
 - b. This test shall be accomplished prior to the burial of the drip lines and any planting being installed.
4. Final Inspection:
 - a. Operate controllers and automatic control valves to demonstrate the complete and successful installation and operation of all equipment.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Any irrigation product will be considered defective if it does not pass tests and inspections.

3.12 FINAL INSTRUCTIONS AND DOCUMENTATION

- A. Program controller according to approved irrigation schedule
- B. Manufacturer of Control Systems shall certify control system is complete, including all related components, and operational. Submit certificate to Contracting Officer's Representative.
- C. As-Built Drawings:
 1. Maintain and provide a complete set of As-Built drawings, which shall be corrected daily to show changes in locations of all pipe, valves, pumps and related irrigation equipment.
 2. Prepare As-Built drawings showing location of all valves, lateral lines, and route of control wires.
 3. See 1.7C As-Built Drawings of this Section for the requirements for the drawings.
- D. Controller Chart
 1. Provide one controller chart showing the area covered by controller for each automatic controller
 2. Use the approved As-Built drawings for the controller chart.
 3. See 1.7D Controller Chart of this Section for the requirements for the controller chart.
- E. Maintenance and Operating Instructions and Manuals

1. Prior to final acceptance, verbal instructions, for a period of not less than 8 hours, shall be provided to the operating personnel. Multiple instructions may be required for a total of 8 hours. Instructions shall be conducted to the satisfaction of the Contracting Officer's Representative. Contractor shall be required to repeat the training at Contractor's own expense until the Contracting Officer's Representative has conclude that the training has be conducted satisfactorily.
2. Deliver manuals to the Contracting Officer's Representative, within 10 Calendar Days of completion of work of this Section and as a condition of its acceptance, to the Contracting Officer's Representative
3. See 1.7E Maintenance and Operating Instructions and Manuals of this Section for the requirements for the Operation and Maintenance Manuals

3.13 MAINTENANCE PERIOD

- A. Maintenance period duration to start on the date of the project final acceptance. The irrigation may be installed and final tested prior to the project completion; however, the system remains in the Contractor's possession until the project is certified complete and formally turned over to the government. The Contracting Officer shall provide written documentation to the Contractor stating this date.
- B. Maintain, make minor adjustments, repair and / or replace any breaks, malfunctions or deficiencies of the irrigation system for the full duration of the 90 day maintenance period.
- C. The Contracting Officer's Representative reserves the right to waive or shorten the maintenance period.

3.14 CLEAN UP

- A. Remove all trash, debris, surplus materials and equipment from the project site when the work of this Section has been completed and at such other times as may be directed by the Contracting Officer's Representative.

3.15 WARRANTY

- A. It shall be the responsibility of the Contractor to fill and repair all depressions and replace all necessary lawn, planting and hard surfaces due to the settlement of irrigation trenches, and to replace all necessary lawn and planting impacted by the lack of proper irrigation coverage due to workmanship for one (1) year following completion and acceptance of the job.

--- E N D ---

SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This work consists of furnishing and installing all planting materials required for landscaping hereinafter specified in locations as shown.

1.2 TESTING LABORATORY SERVICES

- A. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- B. Materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.3 EQUIPMENT

- A. Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.4 RELATED WORK

- A. Section 32 84 00, PLANTING IRRIGATION.
- B. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- C. Sustainable design requirements and procedures including submittal requirements: Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- D. Procedures and requirements for managing and disposing construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's current catalog cuts and specifications of the following:
 - 1. Fertilizers
 - 2. Tree Tie and Stake Materials
 - 3. Root Barrier
 - 4. Iron Sulfate
- B. Samples: Submit following samples along with certificates of compliance / analytical data from approved laboratory for degree of compliance. Submit two samples total of each item: one to Landscape Architect and one to Contracting Officer's Representative.
 - 1. Plants: Submit typical sample of each variety or entire quantity to site for approval by Contracting Officer's Representative.
 - 2. Organic Mulch: Submit 1-pint sample with list of ingredients.
 - 3. Organic (Soil) Amendment: Submit 1-pint sample with Technical Data Sheet and STA

certification.

4. Imported Planting Soil: Submit 1-pint sample.

C. Delivery Receipts

1. Provide delivery receipts for quantities of organic soil amendments delivered to the site.

D. Topsoil Analysis (Soil Management) Report

1. After approval of rough grading and topsoil placement, obtain minimum of four representative one quart samples of topsoil taken from accepted site locations at depth of 4" to 6" below finish grade and submit to an accredited Soils Laboratory for evaluation of physical and chemical properties of soil including all major nutrients; pH, salinity, boron, sodium, micronutrients, copper, zinc, manganese and iron; and infiltration rate, soil texture and organic content, along with a summary describing the degree of compliance with the specified requirements. The report shall also include recommendations for modification of the soil for agricultural suitability.
2. Upon request by Contracting Officer's Representative, submit documentation verifying implementation of soil analysis report recommendations to the local agency with Certificate of Completion as required by the State of California Model Water Ordinance

E. Subsoil Analysis

1. Besides the above required soil samples, take one representative sample of any subgrade soil that is to receive a layer of imported planting soil over it. The laboratory report shall include the subgrade soil's total combined silt and clay content for determining the total desirable combined silt and clay content of the final imported planting soil cover specified herein.

F. Imported Planting Soil Analysis

1. See Imported Planting Soil Analysis requirements elsewhere in this specification for comparison to existing soil analysis.

G. Approval of Laboratory Report

1. Upon approval of the Laboratory's report by the Contracting Officer's Representative, the recommendations in the report shall become a part of the Specifications and the quantities of soil amendment, fertilizer and other additives shall be adjusted to conform with the report at no additional cost to the Government. Request Testing Laboratory to send one copy of test results directly to Contracting Officer's Representative. Note that there is a minimum quantity of organic amendment specified elsewhere in this specification section.

1.6 PROJECT/SITE CONDITIONS

- A. Site Visit: At beginning of work, visit and walk the site with the Contracting Officer's Representative to clarify scope of work and understand existing project/site conditions.

1.7 WARRANTY AND REPLACEMENT

- A. Pre-Emergence Weed Killer: Warrant the work against weed growth for a period of four (4) months after application.
- B. Warrant all plants and planting to be in a healthy, thriving condition until the end of the maintenance period, and deciduous trees beyond that time until active growth is evident.
- C. Replace all dead plants and plants not in a vigorous condition immediately upon discovery and as directed by the Contracting Officer's Representative at Contractor's expense. Install replacement plants before the final acceptance at the size specified.
- D. Warrant all plant material for a period of one year after final acceptance of the maintenance period against plant materials with defects at the time of installation.
- E. Warrant plant installation and maintenance by Contractor against defects for a period of one year.

1.8 QUALITY ASSURANCE

- A. Contractor to submit documentation to the Contracting Officer's Representative within 15 days after award of contract that all plant material is available, listing sources of material.

1.9 DELIVERY AND STORAGE

- A. Delivery:
 - 1. Notify the Contracting Officer's Representative of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
 - 2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in the branches and covering all exposed branches.
 - 3. Deliver fertilizer to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law.
 - 4. During delivery: Protect seed from contamination.
- B. Storage:
 - 1. Keep fertilizer in dry storage away from contaminants.
 - 2. Store plants not installed on the day of arrival at the site as follows:
 - a. Shade and protect plants from the wind when stored outside
- C. Keep plants in a moist condition until planted.

1.10 LIME TREATMENT OF SOIL

- A. Refer to PART 3 -EXECUTION for mitigation of any lime treatment of soils.

1.11 PLANTING INSTALLATION CONDITIONS

- A. Perform planting operations after the irrigation system is installed, tested, and approved.
- B. No work shall be done when the ground is too wet or in an otherwise unsuitable condition for planting. Special conditions may exist that warrants a variance. Submit a written request to the

Contracting Officer's Representative stating the special conditions and proposal variance.

1.12 PLANT ESTABLISHMENT PERIOD

- A. The Establishment Period for plants shall begin immediately after installation, with the approval of the Contracting Officer's Representative, and continue until the date that the Government accepts the project or phase for beneficial use and occupancy. During the Plant Establishment Period the Contractor shall:
1. Water all plants to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of 25 mm (1 inch) of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the mulch or flood the plants.
 2. Prune plants and replace mulch as required.
 3. Replace and restore stakes, guy wires as required.
 4. In all planting areas, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches).
 5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the Contracting Officer's Representative.
 6. Remove plants that die during this period and replace each plant with one of the same size and species.
 7. Check irrigation systems at each watering. Adjust coverage and clean and repair non-functioning heads immediately. Adjust timing of irrigation controller to prevent oversaturation, run-off, or flooding.
 8. Keep Contract areas free from weeds by cultivating, hoeing or hand pulling. Use of chemical weed killers will not relieve the Contractor of the responsibility of keeping areas free of weeds over 1-inch high at all times.
 9. Plant Protection and Replacement
 - a. Protect all areas against damage, including erosion, trespass, insects, rodents, deer, disease, etc. and provide proper safeguards, including trapping of rodent and applying protective sprays and fencing to discourage deer browsing. Maintain and keep all temporary barriers erected to prevent trespass.
 - b. Repair all damaged planted areas. Replace plants immediately upon discovery of damage or loss, including damage from Deer and Rodents.
 10. Fertilizing:
 - a. Upon approval and after submitting fertilizer delivery tags, maintenance fertilization shall begin 30 days after planting is complete. Fertilize all ground cover areas by broadcasting Type C (21-7-14) fertilizer at the rate of 5 lbs. per 1,000 square feet evenly throughout. Reapply every forty-five (45) days until acceptable.

- b. Early spring and fall substitute a complete fertilizer such as 15-15-15 applied at the rate of 6 lbs. per 1,000 square feet, to help insure continuing adequate phosphorus and potassium.
- c. Apply ammonium sulfate fertilizer as necessary to maintain vigorous, green grass between fertilizings mentioned above.
- d. Observe plant's color, and if a soil pH imbalance is suspected, take soil samples and obtain laboratory analysis for confirmation. Take necessary action recommended in laboratory analysis such as top dressing with soil sulfur, leaching soil, etc.

1.13 PLANT WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of FAR clause 52.246-21, including the following supplements:
 1. A One Year Plant Warranty will begin on the date that the Government accepts the project or phase for beneficial use and occupancy. The Contractor shall have completed, located, and installed all plants according to the plans and specifications. All plants are expected to be living and in a healthy condition at the time of final inspection.
 2. The Contractor will replace any dead plant material immediately. A one year warranty for the plants that was replaced, will begin on the day the work is completed.
 3. The Government will reinspect all plants at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material immediately. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification. The Contractor shall also comply with the following requirements:
 - a. Replace dead, missing or defective plant material prior to final inspection.
 - b. Mulch and weed plant beds. Just prior to this inspection, treat these areas to a second application of approved pre-emergent herbicide.
 - c. From plants having been installed for one year, remove stakes, guy wires and any required tree wrappings.
 - d. Complete remedial measures directed by the Contracting Officer's Representative to ensure plant survival.
 - e. Repair damage caused while making plant replacements.

1.14 PLANT MAINTENANCE PERIOD

- A. Contractor shall begin a 90 day Maintenance Period after Complete Project acceptance by the Government. Contractor shall provide a CLIN on the bid documents and approved schedule of values for this Period after acceptance, to be reviewed and approved by the Contracting Officer's Representative.
- B. Replace all dead and damaged plants and plants not in a vigorous condition immediately upon discovery and as directed by the Contracting Officer's Representative. Install replacement plants

before the end of the Maintenance Period.

- C. Keep all walks and paved areas clean. Keep the site clear of debris resulting from landscape work and maintenance operations.
- D. Check irrigation systems at each watering; adjust coverage and clean and repair non-functioning heads immediately. Adjust timing of irrigation controller to prevent runoff and flooding.
- E. Maintain adequate moisture depth in soil to ensure vigorous growth, without overwatering. Check rootball of trees and shrubs independent of surrounding soils and hand water as required.
- F. Keep Contract areas free from weeds by cultivating, hoeing or hand pulling. Use of chemical weed killers will not relieve the Contractor of the responsibility of keeping areas free of weeds over 1-inch high at all times.
- G. Protect all areas against damage, including erosion, trespass, insects, rodents, deer, disease, etc. and provide proper safeguards, including trapping of rodent and applying protective sprays and fencing to discourage deer browsing. Maintain and keep all temporary barriers erected to prevent trespass.
- H. Repair all damaged planted areas. Replace plants immediately upon discovery of damage or loss, including damage from Deer and Rodents.
- I. Maintain during the entire establishment period by regular watering, cultivating, weeding, repair of stakes and ties, and spraying for insect pests. Prune when requested by the Contracting Officer's Representative.
- J. Keep watering basins in good condition and weed-free at all times.
- K. Replace all damaged, unhealthy or dead trees, shrubs, and ground covers with new stock immediately; size as indicated on the drawings.
- L. Upon approval and after submitting fertilizer delivery tags, maintenance fertilization shall begin 30 days after planting is complete. Fertilize all ground cover areas by broad-casting Type C (21-7-14) fertilizer at the rate of 5 lbs. per 1,000 square feet evenly throughout. Reapply every forty-five (45) days until acceptable.
- M. Early spring and fall substitute a complete fertilizer such as 15-15-15 applied at the rate of 6 lbs. per 1,000 square feet, to help insure continuing adequate phosphorus and potassium.
- N. Apply ammonium sulfate fertilizer as necessary to maintain vigorous, green grass between fertilizings mentioned above.
- O. Observe plant's color, and if a soil pH imbalance is suspected, take soil samples and obtain laboratory analysis for confirmation. Take necessary action recommended in laboratory analysis such as top dressing with soil sulfur, leaching soil, etc.
- P. At the conclusion of the Maintenance Period, schedule a final review with the Contracting Officer's Representative. On such date, all project improvements and all corrective work shall have been completed.

- Q. Submit written notice requesting review at least 10 days before the anticipated review.
- R. Prior to review, weed and rake all planted areas, repair plant basins, plumb tree stakes, clear the site of all debris and present in a neat, orderly manner.

1.15 APPLICABLE PUBLICATIONS

- A. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the herein listed codes, regulations or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality, higher standard than is required by the above mentioned codes and regulations, the provisions of these Specifications and Drawings shall take precedence. Furnish without extra charge additional materials and labor required to comply with above rules and regulations
- C. American National Standards Institute (ANSI) Publications:
 - 1. Z60.1-04 Nursery Stock
 - 2. Z133.1-06 Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush- Safety Requirements
- D. Hortus Third, A Concise Dictionary of Plants Cultivated in the U.S. and Canada.
- E. Contractor shall be familiar with and follow the State of California Model Water Ordinance, California Code of Regulations, Title 23 Waters, Division 2, Department of Water Resources, Chapter 2.7. Also, the Contractor is responsible to follow all local water ordinances and the Soil Management/Analysis Report with verifying implementation.
- F. American Society for Testing and Materials (ASTM) Publications:
 - 1. C136-06 Sieve Analysis of Fine and Coarse Aggregates
- G. U. S. Department of Agriculture Federal Seed Act.
 - 1. Rules and Regulations
- H. "Sunset Western Garden Book," Lane Publishing Co., Menlo Park, California; current edition.
- I. US Composting Council Compost analysis Program (CAP)
- J. Test Methods for the Evaluation of Composting and Compost (TMECC)
- K. International Society of Arboriculture, Guide for Plant Appraisal, latest version.
- L. United States Composting Council (USCC) Seal of Testing Assurance (STA) program.
- M. TMECC: Refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC)
- N. References to "Caltrans Standard Specifications" shall mean the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation,

CALTRANS.

- O. Manufacturer's recommendations

PART 2 - PRODUCTS

2.1 GENERAL

- A. All plant material shall conform to the varieties specified or shown in the plant list and be true to botanical name as listed in Hortus Third.

2.2 PLANTS

- A. Plants shall be nursery grown in containers and in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.
- B. Plant the variety, quantity and size indicated. The total quantity tabulated on the drawings are considered approximate and furnished for convenience only. Contractor shall perform his/her own plant quantity calculations and shall provide all plants shown on the Drawings.
- C. Tag plants of the type or name indicated and in accordance with the standard practice recommended by the American Association of Nurserymen.
- D. Install healthy, shapely and well rooted plants with no evidence of having been root-bound, restricted or deformed.
- E. Take precautions to ensure that the plants will arrive at the site in proper condition for successful growth. Protect plants in transit from windburn and sunburn. Protect and maintain plants on site by proper storage and watering.
- F. Substitutions will not be permitted, except as follows:
 - 1. If proof is submitted to the Contracting Officer's Representative that any plant specified is not obtainable, a proposal will be considered for use of nearest equivalent size or variety with an equitable adjustment of contract price.
 - 2. Substantiate and submit proof of plant availability in writing to the Contracting Officer's Representative within 10 days after the effective date of Notice to Proceed.
- G. Tree Form: Trees shall have a symmetrical form as typical for the species/cultivar and growth form.
 - 1. Central Leader for Single Trunk Trees: Trees shall have a single, relatively straight central leader and tapered trunk, free of co dominant stems and vigorous, upright branches that compete with the central leader. Preferably, the central leader should not have been headed; however, in cases where the original leader has been remove, an upright branch at least ½ the diameter of the original leader just below the pruning point shall be present.
 - 2. Potential Main Branches: Braches shall be evenly distributed radially around and appropriately spaced vertically along the trunk, forming a generally symmetrical crown typical

for the species.

3. Headed temporary branches should be distributed around and along the trunk as noted above and shall be no greater than 3/8" diameter, and no greater than 1/2 diameter of the trunk at point of attachment.

H. Tree Trunk

1. Trunk diameter and taper shall be sufficient so that the tree will remain vertical without the support of a nursery stake.
2. Trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.
3. Tree trunk diameter at 6" above the soil surface shall be within the diameter range shown for each container size below, except where shown otherwise:

<u>Container</u>	<u>Trunk Diam. in inches</u>	<u>Soil level from Container Top</u>
24" Box	1.5" to 2.5"	2.25 to 3"
36" Box	2" to 3.5"	

4. Tree trunks shall be undamaged and uncut with all old abrasions and cuts completely callused over. Do not prune plants prior to delivery.

I. Tree Roots

1. Trunk root collar (root crown) and large roots shall be free of circling and/or kinked roots. Contractor may be required to remove soil near the root collar in order to verify that circling and/or kinked roots are not present.
2. The tree shall be well rooted in the container. When the trunk is lifted the trunk and root system shall move as one and the rootball shall remain intact.
3. The top-most roots or root collar shall be within 1" above or below the soil surface. The soil level in the container shall be within the limits shown in above table.
4. The rootball periphery shall be free of large circling and bottom-matted roots.
5. On grafted or budded trees, there shall be no suckers from the root stock.

J. Shrubs

1. Each shrub must stand upright without support.
2. All container shrubs shall be free of girdling roots, defined as those roots greater than 1/8" diameter circling the periphery of the rootball. The top of the rootball shall be free of "Knees" (roots) protruding above the soil, and the bottom shall be free of matted roots.

- #### K. Measure trees and shrubs with branches in normal position. Height and spread dimensions indicated refer to the main body of the plant, and not from branch tip to tip.

- #### L. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the Contracting Officer's Representative authorizes a change order providing for use of the nearest

equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.

2.3 FERTILIZERS

A. Commercial fertilizer, pelleted or granular form, conform to the requirements of Chapter 7, Article 2, of the Agricultural Code of the State of California for fertilizing materials as follows:

1. Type A:

6% Nitrogen, 20% Phosphorus Acid and 20% Potash, (6-20-20).

2. Type B:

21 gram planting tablets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Agriform or 10gm BestPacks packets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Best Fertilizer Co.

3. Type C:

Complete fertilizer 21% Nitrogen, 7% Phosphoric Acid and 14% Potash (21-7-14).

4. If commercial fertilizer having this analysis is not obtainable, other similar commercial fertilizer may be used providing it meets the approval of the Contracting Officer's Representative.

B. Maintenance Fertilizer: Type C

C. Sod Fertilizer: Provided by grower.

2.4 ORGANIC AMENDMENT FOR IN SITU SOILS (ON-GRADE):

A. Ground Redwood or Ground Fir Bark with the following properties:

<u>Percent Passing</u>	<u>Sieve Designation</u>	
100	9.51 mm	3/8"
50-60	6.35 mm	1/4"
20-40	4.76 mm	No. 4
0-20	2.38 mm	No. 8 8 mesh

Redwood Sawdust

Dry bulk density, lbs. per cu. yd., 260-280

Nitrogen stabilized - dry weight basis, min. 0.4%

Salinity (ECe): 4.0 maximum

Organic Content: 90% minimum

Reaction (pH): 4.0 minimum

Ground Fir and/or Pine Bark

Dry bulk density, lbs. per cu. yd., Min. 350

- Nitrogen stabilized - dry weight basis, min. 0.5%
- Salinity (ECe): 4.0 maximum
- Organic Content: 90% minimum
- Reaction (pH): 4.0 minimum

- B. Submit sample along with analytical data from an approved laboratory for degree of compliance to the Contracting Officer's Representative within two weeks after award of Contract.

2.5 IRON SULFATE

- A. Type: Dry form.

2.6 PLANT BACKFILL

- A. Except for acid loving plants (Azaleas, Rhododendrons, Ferns, Camellias, etc.), use a mixture of 2 parts soil from the hole, and 1 part amendment with iron added at the following rates:

<u>Size</u>	<u>Rate</u>
1 gallon can plants	iron, 1/4 cup
5 gallon can plants	iron, 1/3 cup
15 gallon can plants	iron, 1/2 cup
24" box and larger	iron, 1 cup

- 1. Mix the iron, amendment and soil thoroughly for use only in the top 8 inches of backfill around plants. For acid loving plants, mixture to be 1/2 soil from the hole and 1/2 amendment only in the top 8 inches.

2.7 MULCHES

- A. Organic Mulch: Fir tree or pine tree bark, natural; 3/4-inch to 1-inch size, gray to black in color.
- B. Submit samples of organic mulch to the Contracting Officer's Representative for approval within two weeks of award of Contract. Resubmit until acceptable to Contracting Officer's Representative, at no extra cost.

2.8 TREE SUPPORT POLES

- A. Support Poles for trees up to 36" box size.
- B. Type: Peeled lodge pole pine logs, clean, smooth, new, and sized as follows:
 - 1. Two-inch (2") diameter by eight feet (8') long for trees less than 8' high and 1" caliper.
 - 2. Three-inch (3") diameter by eight to ten feet (8' - 10') long for trees greater than 8' high and 1" caliper.

2.9 TREE TIES

- A. Rubber strap, 24-inch minimum length without sharp edges adjacent to trunk.

2.10 TREE ROOT BARRIER

- A. Root Barrier shall be black injection molded panels of .080" wall thickness in modules 24d" long by 24" deep manufactured with a minimum 50% post consumer recycled polypropylene plastic

with added ultraviolet inhibitors, recyclable

- B. Each panel shall have not less than 4 molded integral vertical root deflecting ribs of at least 0.06" thickness protruding 1/2" at 90 degrees from interior of the barrier panel, spaced 6" apart. A double top edge consisting of two parallel, integral, horizontal ribs at the top of the panel of a minimum 0.06" thickness 3/8" wide and 1/4" apart. A minimum of 9 anti-lift tabs consisting of integral horizontal ridges of a minimum 0.06" thickness.
- C. Panels shall have an instant assembly system by sliding one panel into another.

2.11 PLANTING SOIL (TOPSOIL):

- A. Planting soil is defined as screened imported soil. Satisfactory planting soil shall be free of subsoil, clay, lumps, stones, and other objects over 2" in diameter, and without weeds, roots, and other objectionable material.

2.12 IMPORTED PLANTING SOIL (TOPSOIL):

- A. Imported planting soil shall be fertile, friable, natural, productive soil containing a normal amount of humus, and shall be capable of sustaining healthy plant life. Planting soil shall be free of subsoil, heavy or stiff clay, rocks, gravel, brush, roots, weeds, noxious seeds, sticks, trash, and other deleterious substances. Soil shall not be infested with nematodes or with other noxious animal life or toxic substances. Soil shall be obtained from well-drained, arable land, and shall be of an even texture. Soil shall not be taken from areas on which are growing any noxious weeds such as Morning Glory, Sorrel, or Bermuda Grass.
- B. Imported planting soil shall have a pH value of between 6.0 and 7.5, a boron concentration of the saturation extract of less than 1 ppm, salinity of the saturation extract at 25 degrees C. of less than 4.0 millimoles, and a sodium absorption rate (SAR) of less than 8.
- C. The silt and clay content of imported planting soil shall not exceed that of the existing soil it is to be placed over. It shall be a "Sandy Loam" as classified in accordance with USDA Standards with a combined total of between 25% to 40% Clay and Silt. Provide existing site soil sample analysis report for comparison with the imported soil report.
- D. Make the site of the source of supply of planting soil available to the Contracting Officer's Representative for observation and approval prior to any hauling or placing of soil. In addition, submit for approval a 1-quart sample of soil, together with a standard soil analysis report by an accredited soils analyst showing chemical analysis stating source, fertility, agricultural suitability and particle size distribution of the soil. Deliver the sample to the Contracting Officer's Representative two weeks before starting the contemplated hauling of the soil. Following approval of the sample, provide a one-half cubic yard sample, which shall be stored at the site of work for comparison with subsequent loads of soil. The comparison sample shall be protected by a cover until the furnishing of all soil has been completed and accepted. Should the soil submittal lack certain requirements which can be added to the soil, the Contracting Officer's Representative

will consider a request by the Contractor to amend the soil as recommended by the Soils Analyst at the Contractor's expense.

2.13 PRE-EMERGENCE WEED KILLER

- A. Clean non-staining as selected by a licensed pest control specialist.

PART 3 - EXECUTION

3.1 FINE GRADING AND SOIL PREPARATION

A. General:

1. Soil in all planting areas shall be moist, but not so moist that it sticks to a hand shovel, and loose and friable to a minimum depth of 12 inches with a relative maximum compaction of 85%. Rip and scarify and dry any areas that do not meet this requirement.
2. Prior to excavating for plant pits and bed, verify the location of any underground utilities. Damage to utility lines shall be repaired at the Contractor's expense. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction
3. No work shall be done when the ground is too wet or in an otherwise unsuitable condition for earthwork and planting. Special conditions may exist that warrants a variance. Submit a written request to the Contracting Officer's Representative stating the special conditions and proposal variance.
4. Before proceeding with the work: Carefully inspect all areas and verify all dimensions and quantities. Immediately inform the Contracting Officer's Representative of any discrepancy between the drawings and specifications and actual conditions and secure approval to proceed.

B. Lime Treated Soil Removal:

1. Any Lime treated soils shall be removed full depth of treated soil from planting areas and replaced with approved planting soil as accepted by Contracting Officer's Representative. Contractor shall field measure and record all lime treated areas on As Built Drawings showing both depth and areas.
2. Following removal of lime treated material, scarify subgrade to a minimum depth of 6 inches prior to backfilling.
3. Test subgrade in all planting areas for drainage by flooding with 4 inch depth of water puddle and verify complete absorption of standing water within two hours. If standing water is still present after two hours, provide perforated pipe and drain rock "French Drain" system in bottom of non-draining planters and connect to storm drainage system, as accepted by Contracting Officer's Representative.

C. Planting Soil Placement:

1. Inspect planting areas and remove all base rock and other foreign material. Verify placement of planting soil within dripline of trees with Contracting Officer's Representative. Except within tree driplines, rip all planting areas in two directions full depth of compacted fill (to a minimum of 12 inches) into undisturbed native soil prior to backfilling. Scarification of any planting area which cannot be accomplished with a tractor shall be accomplished by an alternative method approved by the Contracting Officer's Representative to the specified depth to ensure proper percolation/drainage.
 2. Prior to placing planting soil secure the Contracting Officer's Representatives acceptance of the planting areas subgrade condition. Test depth of loose soil with hand shovel in presence of Contracting Officer's Representative in several locations as directed. After acceptance of the planting areas subgrade condition, uniformly distribute and spread planting soil backfill over scarified subgrade in planting areas as specified and compact to a maximum of 85% relative compaction.
 3. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.
 4. Water settling, puddling, and jetting of fill and backfill materials as a compaction method is not acceptable.
 5. Provide a minimum of 12" depth in planting areas, or more where shown or specified otherwise.
- D. Planting Soil Placement in Planting Islands and Adjacent to Pavement Areas:
1. Provide planting soil as a final lift in all planting areas within and adjacent to paved areas and other construction where native site soil has been covered by engineered fill and/or base rock. Remove all engineered fill, base rock and compacted subgrade full depth of compaction and replace with approved planting soil, a minimum lift of [12"]. Unless shown otherwise, finish grade in planting islands shall be crowned with a minimum 2 % pitch to the edges.
- E. All planting areas soil shall be loose and friable prior to planting. Rip any overly compacted and re-compacted planting areas in two directions full depth of compacted soil prior to planting.
- F. Planting operations shall be performed only during periods when beneficial results can be obtained. When excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped until conditions are satisfactory.
- G. Thoroughly wet down the planting areas to settle the soil and confirm irrigation coverage and operation. Allow soil to dry so as to be workable as described herein.
- H. Drag to a smooth, even surface. Grade to form all swales. Pitch grade with uniform slope to catch basins, streets, curb, etc., to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas that shall be uniformly sloped between finish elevations. Slope

surface away from walls so water will not stand against walls or buildings. Control surface water to avoid damage to adjoining properties or to finished work on the site. Take required remedial measures to prevent erosion of freshly graded areas and until such time as permanent drainage and erosion control features have been installed. Refer to Erosion Control Netting below for treatment of slopes 3:1 and steeper.

- I. Finish Grade: Hold finish grade and/or mulch surface in planting areas 1/2-inch below adjacent pavement surfaces, tops of curbs, manholes, etc. The subgrade of the mulch in mulched planting areas shall be a minus 2 inches for a distance of 12 to 18 inch from the edge of pavement. The remainder of the planting area shall be graded to receive the required 3 inch layer of mulch.
- J. In Situ Soil Preparation:
 1. Spread organic amendment, iron and Type A fertilizer evenly over installed and rough graded topsoil in all planting areas including ground cover and shrub areas at the following rates:
 - a. Organic Amendment: 6 cubic yards per 1,000 square feet
 - b. Fertilizer: Type A (6-20-20) at 20 lbs. per 1,000 square feet.
 - c. Iron Sulfate: 10 lbs. per 1,000 square feet
 2. Rototill above additives into soil 6 to 8 inches deep. Keep iron sulfate off pavement and other surfaces to prevent rust staining. Correct all rust damage to work.
 3. Planting soil shall have a pH range of 6.5 to 7.5.
- K. After the rototill work, float areas to a smooth, uniform grade as indicated on the drawings. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Remove rocks, sticks and debris 2 inches or larger in shrub and ground cover areas. Secure approval of the grade by the Contracting Officer's Representative before any planting.
- L. Contractor shall notify Contracting Officer's Representative immediately if any planting soil areas have standing water or fail to drain properly prior to plant installation. Review on site with the Contracting Officer's Representative.

3.2 TREE AND SHRUB PLANTING

- A. Mark tree and shrub locations on site using stakes, gypsum or similar approved means and secure location approval by the Contracting Officer's Representative before plant holes are dug. Review location of plants in relationship to irrigation heads and adjust location(s) that interfere with the function of the spray heads as accepted by the Contracting Officer's Representative prior to planting. If Subsurface drip is installed, adjust plant locations in relation to the subsurface emitter as required to ensure that the plant roots receive the proper amount of water in order for it to thrive.
- B. Test drainage of plant pits by filling with water (minimum 6"). The retention of water in planting beds and plant pits for more than two (2) hours shall be brought to the attention of the Contracting Officer's Representative. If rock, underground construction work, tree roots, poor drainage, or

other obstructions are encountered in the excavation of plant pits, alternate locations may be selected by Contracting Officer's Representative.

- C. Break and loosen the sides and bottom of the pit to ensure root penetration and water test hole for drainage as required above.
- D. Backfill plant holes with mix as specified, free from rocks, clods or lumpy material. Backfill native soil free of soil amendments under rootball and foot tamp to prevent settlement. Backfill remainder of the hole with soil mix and place plant tablets or packets (Type B fertilizer) 3 inches below finish grade and 1/2-inch from roots at the following rates:
 - 1.

<u>Size</u>	<u>Rate</u>
1 gallon can plant	1 tablet or packet
5 gallon can plant	3 tablets or packet
15 gallon can plant	6 tablets or packet
24-inch box plant	6 tablets or packet
36-inch box plant	8 tablets or packet
- E. Carefully remove and set plants without damaging the rootball. Superficially cut edge roots vertically on three sides. Remove bottom of plant boxes before planting. Remove sides of boxes after positioning the plant and partially backfilling.
- F. Set plants in backfill with top of the rootball 2 inches above finished grade. Backfill remainder of hole and soak thoroughly by jetting with a hose and pipe section. Water backfill until saturated the full depth of the hole.
- G. Build 6" high watering basin berms around trees and shrubs to drain through rootball. Stake and/or guy trees as detailed and noted herein. Drive stake(s) until solid (at least 12" beyond bottom of rootball) and remove excess stake protruding above top tree tie to prevent rubbing against branches. Avoid driving stakes through rootball. If subgrade does not accept stakes to a stable degree, delete stakes and guy the trees as specified herein and as detailed. Locate tree ties to avoid contact with tree branches. Locate top tie at tree flex point.
- H. Remove any soil from top of plant rootballs and secure Contracting Officer's Representative's approval of rootball height prior to mulching.
- I. After approval of rootball height, install mulch as required below.
- J. Trees damaged during installation, including broken branches, shall be brought to the attention of the Contracting Officer's Representative. Contractor shall replace damaged tree as determined by the Contracting Officer's Representative. If replacement is not necessary, Contractor shall prune damaged branches as directed by the Contracting Officer's Representative and under the direct supervision of a foreman certified by Western Chapter of International Arboriculture Society (WCIAS) and in accordance with WCIAS standards. See 3.7 Tree, Shrub and Vine Pruning.
- K. Coordinate planting and irrigation and provide hand watering of emitter irrigated areas as required

to maintain moist root zones throughout the plant establishment period.

3.3 TREE, SHRUB PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Contracting Officer's Representative, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- C. Do not apply pruning paint to wounds.

3.4 GROUND COVER PLANTING

- A. Plant in neat, straight, parallel and staggered rows as indicated on plan. Plant first row one-half required ground cover spacing behind adjacent curbs, structures, or other plant bed limits. Plant ground cover to edge of water basins of adjacent trees and shrubs.

3.5 MULCH

- A. Mulch all tree, shrub and ground cover areas with organic mulch to a 3-inch depth, except adjacent to walkways where soil grade is 2 inches below top of pavement, mulch shall be 2 inches deep, and 2-inches deep where planting ground cover plants from flats. Hold bark mulch away from base (trunk) of plant 4" or as directed by the Contracting Officer's Representative. Individual trees and/or shrubs planted in non-irrigated areas shall, at minimum, receive bark mulch over their watering basin and berm.

3.6 ROOT BARRIER

- A. Install in linear fashion along and adjacent to the edges of the planting area as detailed or, if not shown, in accordance with manufacturer's recommendations. Set top of barrier approximately ½-inch above finished soil surface to allow concealment with mulch, as accepted by Contracting Officer's Representative.

3.7 PRE-EMERGENCE WEED KILLER

- A. Apply pre-emergence weed killer in all areas to receive ground cover planting. Work shall be done under the supervision of a person licensed by the State of California as a pest control applicator and holding a qualified applicator license or a Qualified Applicator Certificate. Obtain approval of the finish grades prior to applying weed killer and coordinate planting and watering with the pest control specialist prior to planting. Take care to keep weed killer off areas to be seeded.

3.8 WATERING

- A. Water trees, shrubs and ground cover immediately after planting. Apply water to plants as often and in sufficient amount as conditions may require to keep the plants in a healthy vigorous growing condition until completion of the Contract. Do supplemental hand watering of trees and shrubs during the first 3 weeks of plant establishment.

3.9 RESTORATION AND CLEAN-UP

- A. Where existing turf areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas is completed. Remove all debris, rubbish and excess material from the station.

3.10 ENVIRONMENTAL PROTECTION

- A. All work and Contractor operations shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

3.11 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with Contractor's Waste Management Plan and Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the Contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

3.12 FINAL PLANTING REVIEW AND ACCEPTANCE, per Section 01 77 00.

- A. At the conclusion of the Maintenance Period, schedule a final review with the Contracting Officer's Representative (COR). On such date, all project improvements and all corrective work shall have been completed. If all project improvements and corrective work are not completed, continue the planting establishment, at no additional cost to the Government, until all work has been completed. This condition will be waived by the COR under such circumstances wherein the COR has granted an extension of time to permit the completion of a particular portion of the work beyond the time of completion set forth in the Agreement.
- B. Submit written notice requesting review at least 10 days before the anticipated review.
- C. Prior to review, weed and rake all planted areas, repair plant basins, plumb tree stakes, clear the site of all debris and present in a neat, orderly manner.

3.13 FINAL CLEANUP

- A. Remove all trash, debris, surplus materials and equipment from the project site when the work of this Section has been completed and at such other times as may be directed by the Contracting Officer's Representative.

--- END OF SECTION---

**SECTION 33 40 00
STORM SEWER UTILITIES**

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.02 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTHWORK.
- B. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- D. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.03 ABBREVIATIONS

- A. HDPE: High-density polyethylene

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes and catch basins according to manufacturer's written rigging instructions.

1.05 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.06 SUBMITTALS

- A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

1.07 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):

A185/A185M-07	Steel Welded Wire Reinforcement, Plain, for Concrete
A242/A242M-04(2009).....	High-Strength Low-Alloy Structural Steel
A536-84(2009)	Ductile Iron Castings
A615/A615M-09b	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A760/A760M-10	Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
A798/A798M-07	Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
A849-10.....	Post-Applied Coatings, Paving, and Linings for Corrugated Steel Sewer and Drainage Pipe
A929/A929M-01(2007).....	Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
B745/B745M-97(2005).....	Corrugated Aluminum Pipe for Sewers and Drains
B788/B788M-09	Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe
C14-07	Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe
C33/C33M-08.....	Concrete Aggregates
C76-11	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C139-10	Concrete Masonry Units for Construction of Catch Basins and Manholes
C150/C150M-11.....	Portland Cement
C443-10	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C478-09	Precast Reinforced Concrete Manhole Sections
C506-10b	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
C507-10b	Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
C655-09	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C857-07	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

- C891-09Installation of Underground Precast Concrete Utility Structures
- C913-08Precast Concrete Water and Wastewater Structures
- C923-08Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- C924-02(2009)Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
- C990-09Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- C1103-03(2009)Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- C1173-08Flexible Transition Couplings for Underground Piping Systems
- C1433-10Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
- C1479-10Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
- D448-08Sizes of Aggregate for Road and Bridge Construction
- D698-07e1Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
- D1056-07Flexible Cellular Materials—Sponge or Expanded Rubber
- D1785-06Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2321-11Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D2751-05Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
- D2774-08Underground Installation of Thermoplastic Pressure Piping
- D3034-08Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- D3350-10Polyethylene Plastics Pipe and Fittings Materials
- D3753-05e1Glass-Fiber-Reinforced Polyester Manholes and Wetwells
- D4101-11Polypropylene Injection and Extrusion Materials

- D5926-09 Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
- F477-10 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679-08 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- F714-10 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- F794-03(2009) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
- F891-10 Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
- F894-07 Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- F949-10 Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- F1417-11 Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- F1668-08 Construction Procedures for Buried Plastic Pipe
- C. American Association of State Highway and Transportation Officials (AASHTO):
 - M190-04 Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
 - M198-10 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
 - M252-09 Corrugated Polyethylene Drainage Pipe
 - M294-10 Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500 mm) Diameter
- D. American Water Works Association(AWWA):
 - C105/A21.5-10 Polyethylene Encasement for Ductile iron Pipe Systems
 - C110-08 Ductile-Iron and Gray-Iron Fittings
 - C219-11 Bolted, Sleeve-Type Couplings for Plain-End Pipe
 - C600-10 Installation of Ductile iron Mains and Their Appurtenances
 - C900-07 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

- M23-2nd edPVC Pipe "Design And Installation"
- E. American Society of Mechanical Engineers (ASME):
 - A112.6.3-2001..... Floor and Trench Drains
 - A112.14.1-2003..... Backwater Valves
 - A112.36.2M-1991..... Cleanouts
- F. American Concrete Institute (ACI):
 - 318-05 Structural Commentary and Commentary
 - 350/350M-06 Environmental Engineering Concrete Structures and Commentary
- G. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and Sediment Control

1.08 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.01 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.02 PE PIPE AND FITTINGS

- A. Corrugated PE drainage pipe and fittings, NPS 3 to NPS 10 (DN 80 to DN 250); ASTM F714, SDR 21 with smooth waterway for coupling joints.
 - 1. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
- B. Corrugated PE pipe and fittings, NPS 12 to NPS 60 (DN 300 to DN 1500); AASHTO M294, Type S with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
 - 1. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
 - 2. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.

2.03 MANHOLES AND CATCH BASINS

- A. Standard Precast Catch Basins:
 - 1. Provide per details shown on the plans.

2.04 WARNING TAPE

- A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.01 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.02 PIPING INSTALLATION

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 - 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 - 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
 - 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
 - 5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
 - 6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
 - 7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.
- C. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints.

3.03 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.

- B. Set frames and grates to elevations indicated.

3.04 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping.
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.05 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

3.06 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.

3.07 TESTING OF STORM SEWERS:

- A. Submit separate report for each test.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
 4. Submit separate report for each test.
 5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 6. Test force-main storm drainage piping. Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).
 - a. Ductile iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.08 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

--- END OF SECTION---