

# VA PALO ALTO RENOVATE CANTEEN PLAZA

100% Construction Documents Specifications

## VA – Palo Alto Health Care System

Palo Alto, California

DVA PROJECT NO. 640-12-124P

May 16, 2014





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CLAUSES INCORPORATED BY FULL TEXT

52.203-14 DISPLAY OF HOTLINE POSTER(S) (DEC 2007)

(a) Definition.

United States, as used in this clause, means the 50 States, the District of Columbia, and outlying areas.

(b) Display of fraud hotline poster(s). Except as provided in paragraph (c)--

(1) During contract performance in the United States, the Contractor shall prominently display in common work areas within business segments performing work under this contract and at contract work sites--

(i) Any agency fraud hotline poster or Department of Homeland Security (DHS) fraud hotline poster identified in paragraph (b)(3) of this clause; and

(ii) Any DHS fraud hotline poster subsequently identified by the Contracting Officer.

(2) Additionally, if the Contractor maintains a company website as a method of providing information to employees, the Contractor shall display an electronic version of the poster(s) at the website.

(3) Any required posters may be obtained as

follows: Poster(s) Obtain

from [http://www.dhs.gov/xoig/about/gc\\_1163](http://www.dhs.gov/xoig/about/gc_1163)

[703329805.shtm](http://www.dhs.gov/xoig/about/gc_1163)

(i) Appropriate agency name(s) and/or title of applicable Department of Homeland Security fraud hotline poster); and

(ii) The website(s) or other contact information for obtaining the poster(s).)

(c) If the Contractor has implemented a business ethics and conduct awareness program, including a reporting mechanism, such as a hotline poster, then the Contractor need not display any agency fraud hotline posters as required in paragraph (b) of this clause, other than any required DHS posters.

(d) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (d), in all subcontracts that exceed \$5,000,000, except when the subcontract-

(1) Is for the acquisition of a commercial item; or

(2) Is performed entirely outside the United States. (End of clause)

#### 52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984)

The Contractor shall be required to (a) commence work under this contract within 5 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 405 calendar days after receipt of notice to proceed. The time stated for completion shall include final cleanup of the premises.

(End of clause)

#### 52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000)

(a) If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of \$5,000.00 for each calendar day of delay until the work is completed or accepted.

(b) If the Government terminates the Contractor's right to proceed, liquidated damages will

continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause.  
(End of clause)

#### 52.223-2 AFFIRMATIVE PROCUREMENT OF BIOBASED PRODUCTS UNDER SERVICE AND CONSTRUCTION CONTRACTS (SEP 2013)

(a) In the performance of this contract, the contractor shall make maximum use of bio-based products that are United States Department of Agriculture (USDA)-designated items unless--

(1) The product cannot be acquired--

(i) Competitively within a time frame providing for compliance with the contract performance schedule;

(ii) Meeting contract performance requirements; or

(iii) At a reasonable price.

(2) The product is to be used in an application covered by a USDA categorical exemption (see 7 CFR 3201.3(e)).

For example, all USDA-designated items are exempt from the preferred procurement requirement for the following:

(i) Spacecraft system and launch support equipment.

(ii) Military equipment, i.e., a product or system designed or procured for combat or combat-related missions.

(b) Information about this requirement and these products is available at <http://www.biopreferredgov>.

(c) In the performance of this contract, the Contractor shall--

(1) Report to <http://www.sam.gov>, with a copy to the Contracting Officer, on the product types and dollar value of any USDA-designated bio-based products purchased by the Contractor during the previous Government fiscal year, between October 1 and September 30; and

(2) Submit this report no later than--

(i) October 31 of each year during contract performance; and

(ii) At the end of contract performance.

(End of clause)

#### 52.225-9 BUY AMERICAN—CONSTRUCTION MATERIALS (MAY 2014)

(a) Definitions. As used in this clause--

Commercially available off-the-shelf (COTS) item—

(1) Means any item of supply (including construction material) that is--

(i) A commercial item (as defined in paragraph (1) of the definition at FAR 2.101);

(ii) Sold in substantial quantities in the commercial marketplace; and

(iii) Offered to the Government, under a contract or subcontract at any tier, without modification, in the same form in which it is sold in the commercial marketplace; and

(2) Does not include bulk cargo, as defined in 46 U.S.C. 40102(4) such as agricultural products and petroleum products.

Component means an article, material, or supply incorporated directly into a construction material.

Construction material means an article, material, or supply brought to the construction site by the Contractor or a subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

Cost of components means--

(1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

(2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the construction

material. Domestic construction

material means--

(1) An unmanufactured construction material mined or produced in the United States;

(2) A construction material manufactured in the United States, if--

(i) The cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic; or

(ii) The construction material is a COTS item.

Foreign construction material means a construction material other than a domestic construction material. United States means the 50 States, the District of Columbia, and outlying areas.

(b) Domestic preference.

(1) This clause implements 41 U.S.C. chapter 83, Buy American, by providing a preference for domestic construction material. In accordance with 41 U.S.C. 1907, the component test of the Buy American statute is waived for construction material that is a COTS item. (See FAR 12.505(a)(2)). The Contractor shall use only domestic construction material in performing this contract, except as provided in paragraphs (b)(2) and (b)(3) of this clause.

(2) This requirement does not apply to information technology that is a commercial item or to the construction materials or components listed by the Government as follows: None

(3) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(2) of this clause if the Government determines that

(i) The cost of domestic construction material would be unreasonable. The cost of a particular domestic construction material subject to the requirements of the Buy American Act is unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent;

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(c) Request for determination of inapplicability of the Buy American Act. (1)(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(3) of this clause shall include adequate information for Government evaluation of the request, including--

(A) A description of the foreign and domestic construction materials;

(B) Unit of measure;

(C) Quantity;

(D) Price;

(E) Time of delivery or availability;

(F) Location of the construction project;

(G) Name and address of the proposed supplier; and

(H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.

(ii) A request based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause.

(iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).

(iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.

(2) If the Government determines after contract award that an exception to the Buy American statute applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(3)(i) of this clause.

(3) Unless the Government determines that an exception to the Buy American statute applies, use of foreign construction material is noncompliant with the Buy American statute.

(d) Data. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

Foreign and Domestic Construction Materials Price Comparison

Construction material description	Quantity	Unit of measure
		Price (dollars) \1\
-----		
Item 1		
Foreign construction material....	.....	.....
Domestic construction material...	.....	.....
Item 2		
Foreign construction material....	.....	.....
Domestic construction material...	.....	.....
-----		

Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).

List name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.

Include other applicable supporting information.

(End of clause)

## 52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (MAY 2014)

Notwithstanding any other payment terms in this contract, the Government will make invoice payments under the terms and conditions specified in this clause. The Government considers payment as being made on the day a check is dated or the date of an electronic funds transfer. Definitions of pertinent terms are set forth in sections 2.101, 32.001, and 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see paragraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) Invoice payments--(1) Types of invoice payments. For purposes of this clause, there are several types of invoice payments that may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project.

(A) The due date for making such payments is 14 days after the designated billing office receives a proper payment request. If the designated billing office fails to annotate the payment request with the actual date of receipt at the time of receipt, the payment due date is the 14th day after the date of the Contractor's payment request, provided the designated billing office receives a proper payment request and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, is as specified in the contract or, if not specified, 30 days after approval by the Contracting Officer for release to the Contractor.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract).

(A) The due date for making such payments is the later of the following two events:

(1) The 30th day after the designated billing office receives a proper invoice from the Contractor.

(2) The 30th day after Government acceptance of the work or services completed by the Contractor. For a final invoice when the payment amount is subject to contract settlement actions (e.g., release of claims), acceptance is deemed to occur on the effective date of the contract settlement.

(B) If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date is the 30th day after the date of the Contractor's invoice, provided the designated billing office receives a proper invoice and there

is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(2) Contractor's invoice. Prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(xi) of this clause. If the invoice does not comply with these requirements, the designated billing office must return it within 7 days after receipt, with the reasons why it is not a proper invoice. When computing any interest penalty owed the Contractor, the Government will take into account if the Government notifies the Contractor of an improper invoice in an untimely manner.

(i) Name and address of the Contractor.

(ii) Invoice date and invoice number. (The Contractor shall date invoices as close as possible to the date of mailing or transmission.)

(iii) Contract number or other authorization for work or services performed (including order number and contract line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (e.g., discount for prompt payment terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to notify in the event of a defective invoice.

(viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.

(ix) Taxpayer Identification Number (TIN). The Contractor shall include its TIN on the invoice only if required elsewhere in this contract.

(x) Electronic funds transfer (EFT) banking information.

(A) The Contractor shall include EFT banking information on the invoice only if required elsewhere in this contract.

(B) If EFT banking information is not required to be on the invoice, in order for the invoice to be a proper invoice, the Contractor shall have submitted correct EFT banking information in accordance with the applicable solicitation provision (e.g., 52.232-38, Submission of Electronic Funds Transfer Information with Offer), contract clause (e.g., 52.232-33, Payment by Electronic Funds Transfer--System for Award Management, or 52.232-34, Payment by Electronic Funds Transfer--Other Than System for Award Management), or applicable agency procedures.

(C) EFT banking information is not required if the Government waived the requirement to pay by

EFT.

(xi) Any other information or documentation required by the contract.

(3) Interest penalty. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if payment is not made by the due date and the conditions listed in paragraphs (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday, the designated payment office may make payment on the following working day without incurring a late payment interest penalty.

(i) The designated billing office received a proper invoice.

(ii) The Government processed a receiving report or other Government documentation authorizing payment and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) Computing penalty amount. The Government will compute the interest penalty in accordance with the Office of Management and Budget prompt payment regulations at 5 CFR part 1315.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in paragraph (a)(1)(ii) of this clause, Government acceptance or approval is deemed to occur constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. If actual acceptance or approval occurs within the constructive acceptance or approval period, the Government will base the determination of an interest penalty on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The prompt payment regulations at 5 CFR 1315.10(c) do not require the Government to pay interest penalties if payment delays are due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. The Government and the Contractor shall resolve claims involving disputes, and any interest that may be payable in accordance with the clause at FAR 52.233-1, Disputes.

(5) Discounts for prompt payment. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if the Government takes a discount for prompt payment improperly. The Government will calculate the interest penalty in accordance with the prompt payment regulations at 5 CFR part 1315.

(6) Additional interest penalty. (i) The designated payment office will pay a penalty amount,

calculated in accordance with the prompt payment regulations at 5 CFR part 1315 in addition to the interest penalty amount only if--

(A) The Government owes an interest penalty of \$1 or more;

(B) The designated payment office does not pay the interest penalty within 10 days after the date the invoice amount is paid; and

(C) The Contractor makes a written demand to the designated payment office for additional penalty payment, in accordance with paragraph (a)(6)(ii) of this clause, postmarked no later than 40 days after the date the invoice amount is paid.

(ii)(A) The Contractor shall support written demands for additional penalty payments with the following data. The Government will not request any additional data. The Contractor shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) If there is no postmark or the postmark is illegible--

(1) The designated payment office that receives the demand will annotate it with the date of receipt provided the demand is received on or before the 40th day after payment was made; or

(2) If the designated payment office fails to make the required annotation, the Government will determine the demand's validity based on the date the Contractor has placed on the demand, provided such date is no later than the 40th day after payment was made.

(b) Contract financing payments. If this contract provides for contract financing, the Government will make contract financing payments in accordance with the applicable contract financing clause.

(c) Subcontract clause requirements. The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following: None

(1) Prompt payment for subcontractors. A payment clause that obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) Interest for subcontractors. An interest penalty clause that obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the

date on which payment of the amount due is made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under 41 U.S.C. 7109 in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(3) Subcontractor clause flowdown. A clause requiring each subcontractor to use:

(i) Include a payment clause and an interest penalty clause conforming to the standards set forth in paragraphs (c)(1) and (c)(2) of this clause in each of its subcontracts; and

(ii) Require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) Subcontract clause interpretation. The clauses required by paragraph (c) of this clause shall not be construed to impair the right of the Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that--

(1) Retainage permitted. Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(2) Withholding permitted. Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) Withholding requirements. Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) The Contractor furnishes to the Contracting Officer a copy of any notice issued by a Contractor pursuant to paragraph (d)(3)(i) of this clause.

(e) Subcontractor withholding procedures. If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) Subcontractor notice. Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) Contracting Officer notice. Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to paragraph (e)(1) of this clause;

(3) Subcontractor progress payment reduction. Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (e)(1) of this clause;

(4) Subsequent subcontractor payment. Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefore must be recovered from the Government because of a reduction under paragraph (e)(5)(i) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under 41 U.S.C. 7109 in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) Notice to Contracting Officer. Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under paragraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) Interest to Government. Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under paragraph (e)(5)(i) of this clause.

(f) Third-party deficiency reports—

(1) Withholding from subcontractor. If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a "second-tier subcontractor") a written notice in accordance with 40 U.S.C. 3133, asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under paragraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) Subsequent payment or interest charge. As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall--

(i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or

(ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of 41 U.S.C. 7109 in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) Written notice of subcontractor withholding. The Contractor shall issue a written notice of any withholding to a subcontractor (with a copy furnished to the Contracting Officer), specifying--

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) Subcontractor payment entitlement. The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) Prime-subcontractor disputes. A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the Government is a party. The Government may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) Preservation of prime-subcontractor rights. Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) Non-recourse for prime contractor interest penalty. The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under

paragraph (c) of this clause shall not be construed to be an obligation of the Government for such interest penalty. A cost-reimbursement claim may not include any amount for reimbursement of such interest penalty.

(l) Overpayments. If the Contractor becomes aware of a duplicate contract financing or invoice payment or that the Government has otherwise overpaid on a contract financing or invoice payment, the Contractor shall--

(1) Remit the overpayment amount to the payment office cited in the contract along with a description of the overpayment including the--

(i) Circumstances of the overpayment (e.g., duplicate payment, erroneous payment, liquidation errors, date(s) of overpayment);

(ii) Affected contract number and delivery order number if applicable;

(iii) Affected contract line item or subline item, if applicable; and

(iv) Contractor point of contact.

(2) Provide a copy of the remittance and supporting documentation to the Contracting Officer.

(End of clause)

#### 52.236-1 PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984)

The Contractor shall perform on the site, and with its own organization, work equivalent to at least 20 percent of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

(End of clause)

#### 52.236-4 PHYSICAL DATA (APR 1984)

Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(a) The indications of physical conditions on the drawings and in the specifications are the result of site investigations by the Government.

(b) Weather conditions: The Contractor shall satisfy himself/herself as to the hazards likely to arise from weather conditions. Complete weather records and reports may be obtained from any U.S. Weather Bureau Office.

(c) Transportation facilities: The Contractor shall make his/her own investigation of the conditions of existing public and private roads and of clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress at the job site. The

unavailability of transportation facilities or limitations thereon shall not become a basis for claims against the Government or extension of time for completion of the work.

(End of clause)

#### 52.243-4 CHANGES (JUN 2007)

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

- (1) In the specifications (including drawings and designs);
- (2) In the method or manner of performance of the work;
- (3) In the Government-furnished property or services; or
- (4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating

- (1) the date, circumstances, and source of the order and
- (2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after

(1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of the proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

(End of clause)

## 52.244-2 SUBCONTRACTS (OCT 2010)

(a) Definitions. As used in this clause--

Approved purchasing system means a Contractor's purchasing system that has been reviewed and approved in accordance with Part 44 of the Federal Acquisition Regulation (FAR).

Consent to subcontract means the Contracting Officer's written consent for the Contractor to enter into a particular subcontract.

Subcontract means any contract, as defined in FAR Subpart 2.1, entered into by a subcontractor to furnish supplies or services for performance of the prime contract or a subcontract. It includes, but is not limited to, purchase orders, and changes and modifications to purchase orders.

(b) When this clause is included in a fixed-price type contract, consent to subcontract is required only on unpriced contract actions (including unpriced modifications or unpriced delivery orders), and only if required in accordance with paragraph (c) or (d) of this clause.

(c) If the Contractor does not have an approved purchasing system, consent to subcontract is required for any subcontract that—

(1) Is of the cost-reimbursement, time-and-materials, or labor-hour type; or

(2) Is fixed-price and exceeds—

(i) For a contract awarded by the Department of Defense, the Coast Guard, or the National Aeronautics and Space Administration, the greater of the simplified acquisition threshold or 5 percent of the total estimated cost of the contract; or

(ii) For a contract awarded by a civilian agency other than the Coast Guard and the National Aeronautics and Space Administration, either the simplified acquisition threshold or 5 percent of the total estimated cost of the contract.

(d) If the Contractor has an approved purchasing system, the Contractor nevertheless shall obtain the Contracting Officer's written consent before placing the following subcontracts:

None

(e)(1) The Contractor shall notify the Contracting Officer reasonably in advance of placing any subcontract or modification thereof for which consent is required under paragraph (b), (c), or (d) of this clause, including the following information:

(i) A description of the supplies or services to be subcontracted.

(ii) Identification of the type of subcontract to be used.

- (iii) Identification of the proposed subcontractor.
- (iv) The proposed subcontract price.
- (v) The subcontractor's current, complete, and accurate certified cost or pricing data and Certificate of Current Cost or Pricing Data, if required by other contract provisions.
- (vi) The subcontractor's Disclosure Statement or Certificate relating to Cost Accounting Standards when such data are required by other provisions of this contract.
- (vii) A negotiation memorandum reflecting—
  - (A) The principal elements of the subcontract price negotiations;
  - (B) The most significant considerations controlling establishment of initial or revised prices;
  - (C) The reason certified cost or pricing data were or were not required;
  - (D) The extent, if any, to which the Contractor did not rely on the subcontractor's certified cost or pricing data in determining the price objective and in negotiating the final price;
  - (E) The extent to which it was recognized in the negotiation that the subcontractor's certified cost or pricing data were not accurate, complete, or current; the action taken by the Contractor and the subcontractor; and the effect of any such defective data on the total price negotiated;
  - (F) The reasons for any significant difference between the Contractor's price objective and the price negotiated; and
  - (G) A complete explanation of the incentive fee or profit plan when incentives are used. The explanation shall identify each critical performance element, management decisions used to quantify each incentive element, reasons for the incentives, and a summary of all trade-off possibilities considered.
- (2) The Contractor is not required to notify the Contracting Officer in advance of entering into any subcontract for which consent is not required under paragraph (c), (d), or (e) of this clause.
  - (f) Unless the consent or approval specifically provides otherwise, neither consent by the Contracting Officer to any subcontract nor approval of the Contractor's purchasing system shall constitute a determination—
    - (1) Of the acceptability of any subcontract terms or conditions;
    - (2) Of the allowability of any cost under this contract; or
    - (3) To relieve the Contractor of any responsibility for performing this contract.

(g) No subcontract or modification thereof placed under this contract shall provide for payment on a cost-plus-a- percentage-of-cost basis, and any fee payable under cost-reimbursement type subcontracts shall not exceed the fee limitations in FAR 15.404-4(c)(4)(i).

(h) The Contractor shall give the Contracting Officer immediate written notice of any action or suit filed and prompt notice of any claim made against the Contractor by any subcontractor or vendor that, in the opinion of the Contractor, may result in litigation related in any way to this contract, with respect to which the Contractor may be entitled to reimbursement from the Government.

(i) The Government reserves the right to review the Contractor's purchasing system as set forth in FAR Subpart 44.3.

(j) Paragraphs (c) and (e) of this clause do not apply to the following subcontracts, which were evaluated during negotiations: None  
(End of clause)

#### 52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994)

(a) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(1) The Contractor's failure to conform to contract requirements; or

(2) Any defect of equipment, material, workmanship, or design furnished.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

(e) The Contracting Officer shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.

(f) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the Government shall have the right to replace, repair, or otherwise

remedy the failure, defect, or damage at the Contractor's expense.

(g) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

- (1) Obtain all warranties that would be given in normal commercial practice;
- (2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and
- (3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(h) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(i) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government or for the repair of any damage that results from any defect in Government-furnished material or design.

(j) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.  
(End of clause)

#### 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at this/these address(es):

<http://www.acgnet.gov>

(End of clause)

#### 52.252-4 ALTERATIONS IN CONTRACT (APR 1984)

Portions of this contract are altered as follows: N/A (End of clause)

#### 52.252-6 AUTHORIZED DEVIATIONS IN CLAUSES (APR 1984)

(a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the date of the clause.

(b) The use in this solicitation or contract of any Department of Defense FAR Supplement (48 CFR Chapter 2) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation. (End of clause)

**Defense Federal Acquisition Regulation Supplement (DFARS) and Procedures, Guidance, and Information (PGI)**

252.203-7004 Display of Fraud Hotline Poster(s) (DEC 2012)

(a) Definition. United States, as used in this clause, means the 50 States, the District of Columbia, and outlying areas.

(b) Display of fraud hotline poster(s).

(1) The Contractor shall display prominently in common work areas within business segments performing work in the United States under Department of Defense (DoD) contracts DoD hotline posters prepared by the DoD Office of the Inspector General. DoD hotline posters may be obtained via the Internet at [http://www.dodig.mil/HOTLINE/hotline\\_posters.htm](http://www.dodig.mil/HOTLINE/hotline_posters.htm).

(2) If the contract is funded, in whole or in part, by Department of Homeland Security (DHS) disaster relief funds, the DHS fraud hotline poster shall be displayed in addition to the DoD fraud hotline poster. If a display of a DHS fraud hotline poster is required, the Contractor may obtain such poster from:

Office of Inspector General/MAIL STOP 0305  
Department of Homeland Security  
245 Marray Lane SW  
Washington, DC 20528-0305

(3) Additionally, if the Contractor maintains a company website as a method of providing information to employees, the Contractor shall display an electronic version of the poster(s) at the website.

(c) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (c), in all subcontracts that exceed \$5 million except when the subcontract--

(1) Is for the acquisition of a commercial item; or

(2) Is performed entirely outside the United States. (End of clause)

252.236-7001 CONTRACT DRAWINGS AND SPECIFICATIONS (AUG 2000)

(a) The Government will provide to the Contractor, without charge, one set of contract drawings and specifications, except publications incorporated into the technical provisions by reference, in electronic or paper media as chosen by the Contracting Officer.

(b) The Contractor shall--

- (1) Check all drawings furnished immediately upon receipt;
- (2) Compare all drawings and verify the figures before laying out the work;
- (3) Promptly notify the Contracting Officer of any discrepancies;
- (4) Be responsible for any errors that might have been avoided by complying with this paragraph (b); and
- (5) Reproduce and print contract drawings and specifications as needed.

(c) In general--

- (1) Large-scale drawings shall govern small-scale drawings; and
- (2) The Contractor shall follow figures marked on drawings in preference to scale measurements.

(d) Omissions from the drawings or specifications or the misdescription of details of work that are manifestly necessary to carry out the intent of the drawings and specifications, or that are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work. The Contractor shall perform such details as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings. (End of clause)

#### 252.236-7004 PAYMENT FOR MOBILIZATION AND DEMOBILIZATION (DEC 1991)

(a) The Government will pay all costs for the mobilization and demobilization of all of the Contractor's plant and equipment at the contract lump sum price for this item.

- (1) 60 percent of the lump sum price upon completion of the contractor's mobilization at the work site.
- (2) The remaining 40 percent upon completion of demobilization.

(b) The Contracting Officer may require the Contractor to furnish cost data to justify this portion of the proposal if the Contracting Officer believes that the percentages in paragraphs (a) (1) and (2) of this clause do not bear a reasonable relation to the cost of the work in this contract.

(1) Failure to justify such price to the satisfaction of the Contracting Officer will result in payment, as determined by the Contracting Officer, of --

- (i) Actual mobilization costs at completion of mobilization;
- (ii) Actual demobilization costs at completion of demobilization; and

(iii) The remainder of this item in the final payment under this contract.

The Contracting Officer's determination of the actual costs in paragraph (b)(1) of this clause is not subject to appeal.

**VA Acquisition Regulation (VAAR):**

852.236-84 Schedule of work progress

SCHEDULE OF WORK PROGRESS (NOV 1984)

(a) The contractor shall submit with the schedule of costs, a progress schedule that indicates the anticipated installation of work versus the elapsed contract time, for the approval of the contracting officer. The progress schedule time shall be represented in the form of a bar graph with the contract time plotted along the horizontal axis. The starting date of the schedule shall be the date the contractor receives the "Notice to Proceed." The ending date shall be the original contract completion date. At a minimum, both dates shall be indicated on the progress schedule. The specific item of work, i.e., "Excavation", "Floor Tile", "Finish Carpentry", etc., should be plotted along the vertical axis and indicated by a line or bar at which time(s) during the contract this work is scheduled to take place. The schedule shall be submitted in triplicate and signed by the contractor.

(b) The actual percent completion will be based on the value of installed work divided by the current contract amount. The actual completion percentage will be indicated on the monthly progress report.

(c) The progress schedule will be revised when individual or cumulative time extensions of 15 calendar days or more are granted for any reason. The revised schedule should indicate the new contract completion date and should reflect any changes to the installation time(s) of the items of work affected.

(d) The revised progress schedule will be used for reporting future scheduled percentage completion.

(End of Clause)

852.236-91 Special notes

SPECIAL NOTES (JUL 2002)

(a) Signing of the bid shall be deemed to be a representation by the bidder that:

(1) Bidder is a construction contractor who owns, operates, or maintains a place of business, regularly engaged in construction, alteration, or repair of buildings, structures, and communications facilities, or other engineering projects, including furnishing and installing of necessary equipment; or

(2) If newly entering into a construction activity, bidder has made all necessary arrangements for personnel, construction equipment, and required licenses to perform construction work; and

(3) Upon request, prior to award, bidder will promptly furnish to the Government a statement of facts in detail as to bidder's previous experience (including recent and current contracts), organization (including company officers), technical qualifications, financial resources and facilities available to perform the contemplated work.

(b) Unless otherwise provided in this contract, where the use of optional materials or construction is permitted, the same standard of workmanship, fabrication and installation shall be required irrespective of which option is selected. The contractor shall make any change or adjustment in connecting work or otherwise necessitated by the use of such optional material or construction, without additional cost to the Government.

(c) When approval is given for a system component having functional or physical characteristics different from those indicated or specified, it is the responsibility of the contractor to furnish and install related components with characteristics and capacities compatible with the approved substitute component as required for systems to function as noted on drawings and

specifications. There shall be no additional cost to the Government.

(d) In some instances it may have been impracticable to detail all items in specifications or on drawings because of variances in manufacturers' methods of achieving specified results. In such instances the contractor will be required to furnish all labor, materials, drawings, services and connections necessary to produce systems or equipment which are completely installed, functional, and ready for operation by facility personnel in accordance with their intended use.

(e) Claims by the contractor for delay attributed to unusually severe weather must be supported by climatological data covering the period and the same period for the 10 preceding years. When the weather in question exceeds in intensity or frequency the 10-year average, the excess experienced shall be considered "unusually severe." Comparison shall be on a monthly basis. Whether or not unusually severe weather in fact delays the work will depend upon the effect of weather on the branches of work being performed during the time under consideration.  
(End of Clause)

--- End of Section ---

**SECTION 00 73 19**  
**HEALTH AND SAFETY REQUIREMENTS**

**PART 1 INTRODUCTION**

**1.1 REGULATORY REQUIREMENTS**

A. United States Department of Labor, Occupation Safety and Health Administration (OSHA): Code of Federal Regulation (CFR), Labor Code 29:

1. 1903 - Inspections, Citations, and Proposed Penalties
2. 1904 - Recording and Reporting
3. 1910 - General Industry Standards
4. 1926 - Safety and Health Regulations for Construction

**1.2 STATION REQUIREMENTS**

The following Permits and associated activities require meeting with VA Palo Alto Engineering staff; paperwork demonstrating Work plans meeting 29 CFR's parts above will be required:

- A. Hot Work Permit
- B. Confined Spaces Permit
- C. Electrical Outage Permit

**1.3 SUBMITTALS**

- A. Approved Hot Work Permit
- B. Approved Confined Spaces Permit
- C. Electrical Outage Permit
- D. SSHO Personnel Qualifications

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

**3.1 SITE SAFETY AND HEALTH OFFICER (SSHO)**

- A. Provide SSHO to ensure Work safety at all times.
- B. SSHO shall have direct authority to act immediately on behalf of the Contractor on safety matters.
- C. Perform safety and occupational health management, surveillance, inspections, and safety enforcement at all times.

#### D. Personnel Qualifications

Provide proof of meeting these Personnel Qualifications:

1. Minimum of five years safety work on similar projects.
2. 30-hour OSHA construction safety class or equivalent within the last five years.
3. Average of at least 24 hours of formal safety training each year for the past five years.
4. Fluency in English.

E. Government Approval: The COR may ask for replacement of SSHO; provide replacement meeting these standards.

#### 3.2 STOP WORK

The COR may stop Work at any time for any apparent violation of Health and Safety Requirements at no cost to the Government. The Work stoppage will remain in effect until successfully demonstrating to the COR that all safety violation conditions have been remedied.

#### 3.3 EMERGENCY MEDICAL TREATMENT

Arrange for emergency medical treatment. Government has no responsibility to provide emergency medical treatment. Submit plan to address emergencies to the CO for approval.

#### 3.4 REGULATORY CITATIONS AND VIOLATIONS.

Notify the COR immediately of any OSHA or other regulatory agency inspection or visit, and provide a copy of each citation or report and the Contractor's response. Correct violations and citations promptly and provide report of resolutions.

#### 3.5 UNFORESEEN HAZARDOUS MATERIAL

If potentially hazardous materials (such as PCB, lead paint, and friable and non-friable asbestos), not indicated on plans, are encountered, stop that portion of work and notify the COR and CO immediately for resolution.

--- End of Section ---

**SECTION 01 11 00  
SUMMARY OF WORK**

**PART 1 GENERAL**

1.1 LOCATION

1.2 GENERAL DESCRIPTION

Renovation of outdoor spaces immediately adjacent to Building 101, to Building 100, the Aquatic Therapy Center, the Recreation Therapy Building, and the Rose Garden. The Work includes new outdoor seating areas, pedestrian paths, signage, outdoor pavilions, landscaping, and lighting.

**PART 2 PRODUCTS**

(Not Used)

**PART 3 EXECUTION**

(Not Used)

--End of Section--

**01 14 00  
WORK RESTRICTIONS**

**PART 1 GENERAL**

1.1 OBSERVED FEDERAL HOLIDAYS

1. New Year's Day, January 1
2. Martin Luther King, Jr, 3rd Monday in January
3. Washington's Birthday, 3rd Monday in February
4. Memorial Day, Last Monday in May
5. Independence Day, July 4
6. Labor Day, 1st Monday in September
7. Columbus Day, 2nd Monday in September
8. Veterans Day, November 11
9. Thanksgiving Day, 4th Thursday in November Christmas Day, December 25
10. Any date specifically declared by the President of the United States of America as a National Holiday. \*

\* In general, Federal Holidays falling on a Saturday are observed on the preceding Friday; Federal Holiday falling on a Sunday are observed on the following Monday.

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

3.1 WORKING HOURS

- A. All construction work on the contract shall be performed between 8:00 am and 4:30 pm Monday through Friday, excluding Federal Holidays, unless approved by VA.

-- End of Section --

**01 14 16  
COORDINATION WITH  
OCCUPANTS**

**PART 1 GENERAL**

(Not Used.)

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

**3.1 AVOIDANCE OF INTERRUPTION**

- A. No utility service such as water, gas, steam, sewer, electricity, fire protection, or communications systems may be interrupted without prior approval of COR.
- B. 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 Construction Project Manager/COR. Work may be required to occur outside of normal working hours.
  - 1. Use shields or other physical barriers to restrict noise transmission.
  - 2. Provide soundproof housings or enclosures for noise-producing machinery.
  - 3. Use efficient silencers on equipment air intakes.
  - 4. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
  - 5. Line hoppers and storage bins with sound deadening material.
  - 6. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.

-- End of Section --

**01 14 19  
USE OF SITE**

**PART 1 GENERAL**

**1.1 REFERENCES**

- A. Veterans Administration Palo Alto Health Care Services (VAPAHCS) Regulations

**1.2 SECURITY BADGE**

- A. Each employee shall obtain a VA Palo Alto issued security badge before conducting Work. Identification badges will be furnished without charge. Badges are issued by reporting to the Security Office at the Palo Alto Division, Building 101. Immediately report instances of lost or stolen badges to the Security Office.

**1.2 SITE REGULATIONS**

- A. Abide by standard VAPAHCS Regulations (available from Security Office)

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

(Not Used.)

--End of Section--

**SECTION 01 30 00  
ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Updated personnel list
- B. Contact requirements

1.2 SUBMITTALS

- A. Preconstruction Submittals: List of contact personnel

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

3.1 CONTRACTOR PERSONNEL REQUIREMENTS

- A. Furnish a list of Contact personnel including subcontractors.
  - 1. Including addresses and telephone numbers.
  - 2. As changes occur, submit corrected information.

3.2 ELECTRONIC MAIL (E-MAIL)

- A. Establish and maintain electronic mail (e-mail) capability.
- B. Route communication with Government through email; follow up field Contract communications through email.

-- End of Section --

**SECTION 01 31 26  
COORDINATION AND MEETINGS**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Weekly Progress Meeting and minutes

**PART 2 PRODUCTS**

2.1 PROGRESS MEETING MINUTES

**PART 3 EXECUTION**

3.1 WEEKLY PROGRESS MEETINGS

- A. Make arrangements to meet weekly with the VA.
- B. Prepare and send agendas at least 24 hours in advance and preside at these meetings.
- C. Discuss Work progress and compare to approved Schedule.
- D. Address the status of RFI's, RFP's, and submittal status.
- E. Address other timely Sections' requirements.
- F. Record minutes.
- G. Send out minutes by the end of the next business day.
- H. The Government shall be allowed to review meeting minutes and make comments and notes for inclusion.
- I. Comments shall be reviewed and incorporated into re-submissions for approval by the following business day until resolved.

---End of Section---





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

**PART 1-GENERAL**

1.1 RELATED SECTIONS

- A. 01 45 29 TESTING LABORATORY SERVICES

1.2 GOVERNMENT ACCEPTANCE

- A. Acceptance of Submittals only constitutes that Work may continue. Work remains subject to final acceptance during Close-Out.
- B. In the event the submittal is not accepted, Work may be stopped by the CO until corrective action is taken and approved at no additional cost to the VA. This will not relieve the Contractor of responsibility to meet the Project schedule as accepted.

**PART 2 - PRODUCTS**

(Not Used.)

**PART 3 – EXECUTION**

3.1 SUBMITTAL PROCEDURES

- A. Submit for approval items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements.
- B. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement and required testing. Delays attributable to untimely and rejected submittals will not serve as a basis for extending contract time for completion.
- C. Resubmit Submittals that have been disapproved until acceptance without consequence to approved schedule.
- D. After an item has been approved, no change in brand or make will be considered for approval unless:
  - 1. Evidence is presented that manufacturer cannot make scheduled delivery of approved item.

2. Item delivered has been rejected and substitution of a suitable item is being submitted.
  3. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- E. Submittals will be considered only when accompanied by Transmittal Letter. Transmittal Letter shall include:
1. Name of Contractor.
  2. Contract number.
  3. Applicable specification paragraph numbers, drawing numbers.
  4. Manufacturer and brand.
  5. ASTM or Federal Specification Number (if any).
  6. Catalogs marked to indicate specific items.
  7. Required lab results and certifications.
  6. Such additional information as may be required by specifications.
  9. Signature from Contractor assuring Contract compliance.
- F. The Government reserves the right to require additional submittals if further needed to determine compliance.

- - - End of Section - - -

**SECTION 01 45 01  
QUALITY CONTROL**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Plans, procedures, and organization of Contractor Quality Control System (QC).

1.2 RELATED SECTIONS

- A. 00 72 00 GENERAL CONDITIONS, FAR 52.246-12, Inspection of Construction.

1.3 PAYMENT PROCEDURES

Separate payment will not be made for providing and maintaining an effective QC.

1.4 SUBMITTALS

- B. QC Plan

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

3.1 QC

Establish and maintain an effective QC in compliance with FAR 52.246-12.

3.2 QC PLAN

- A. Submit a QC Plan for approval within 30 calendar days after NTP.
- B. Work shall not begin without acceptance of the QC Plan or acceptance of an interim plan applicable to the particular feature of work.
- C. After acceptance of the QC Plan, notify the Government in writing of any proposed change. Proposed changes are subject to acceptance by the CO.

3.3 NOTIFICATION OF NONCOMPLIANCE

The VA will notify the Contractor of any detected noncompliance with the accepted plan. Take immediate corrective action after receipt of such notice. If the Contractor fails or refuses to comply promptly, the CO may issue an order stopping all or part of the Work until satisfactory corrective action has been taken at no additional cost to the Government.

---End of Section---

**SECTION 01 45 29**  
**TESTING LABORATORY SERVICES**

**PART 1 GENERAL**

**1.1 REFERENCES**

American Society for Testing and Materials (ASTM)

E329 Standard Specification for Agencies Engaged in Construction Inspection,  
Testing, or Special Inspection

E543 Standard Specification for Agencies Performing Nondestructive Testing

C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for  
Use in Construction and Criteria for Testing Agency Evaluation

D3666 Standard Specification for Minimum Requirements for Agencies Testing and  
Inspecting Road and Paving Materials

D3740 Standard Practice for Minimum Requirements for Agencies Engaged in Testing  
and/or Inspection of Soil and Rock as Used in Engineering Design and  
Construction

**1.2 ASTM INSPECTION AGENCY ACCREDITATION REQUIREMENTS**

- A. Testing of construction materials: ASTM E329
- B. Testing of concrete and concrete aggregates: ASTM C1077
- C. Testing of bituminous paving materials: ASTM D3666
- D. Testing of soil and rock: ASTM D3740
- E. Non-destructive testing (NDT): ASTM E543

**1.3 REPORT REQUIREMENTS**

- A. Provide ASTM accredited laboratory certification with required test results.

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 – EXECUTION**

(Not Used.)

--- End of Section ---

**SECTION 01 51 00  
TEMPORARY UTILITIES**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

00 73 19 HEALTH AND SAFETY REQUIREMENTS, 29 CFR 1926, Subpart K

1.2 REFERENCES

NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 70, Article 305-6(b): Assured Equipment Grounding Conductor Program

1.3 REGULATORY REQUIREMENTS

Temporary wiring shall be in accordance with NFPA 241 and NFPA 70, Article 305-6(b).

**PART 2 PRODUCTS**

**PART 3 EXECUTION**

3.1 AVAILABILITY AND USE OF UTILITY SERVICES

- A. On-site electrical services will be made available at the prevailing rates.
  - 1. Construction related energy needs are chargeable and shall be metered and paid for by the Contractor.
  - 2. Provide necessary temporary connections, distribution lines, and meters.
  - 3. Provide monthly record of electricity usage.
- B. Water will be made available for construction and testing.
  - 1. Provide reduced pressure backflow preventer at each connection.
  - 2. Maintain connections, pipe, fittings, and fixtures.
  - 3. Conserve use.

3.2 HEAT

- A. Furnish temporary heat to prevent damage to work and materials.

---End of Section---

**SECTION 01 52 19  
SANITARY FACILITIES**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

- A. 00 73 19 HEALTH AND SAFETY REQUIREMENTS, 29 CFR 1926.51, Sanitation

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

3.1 TOILETS

- A. Provide chemical temporary toilet(s) and sanitation facilities within fenced-in Project area.

--- End of Section ---

**SECTION 01 56 26**  
**TEMPORARY FENCING**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Temporary construction fencing around construction, staging, and storage areas.

**PART 2 PRODUCTS**

2.1 TEMPORARY FENCING

- A. Chain link, 2.1m (7 feet) minimum height.
- B. Fence posts driven, in lieu of concrete bases, where soil conditions permit.
- C. Plastic strip inserts, colored green so that visibility through the fence is obstructed.
  - 1. 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).
- D. Provide gates as required for access, including hasps and padlocks.
- E. Bottom of fences shall extend to within 50 mm (2 inches) above grade.

**PART 3 EXECUTION**

3.1 FENCING INSTALLATION AND MAINTENANCE

- A. Provide fencing before construction operations begins.
- B. Ensure fence stability.
- C. Stage equipment or materials out of public view with the exception of those items which are in support of ongoing Work on any given day.
- D. Keep fence in state of good repair and proper alignment.
- E. Remove fencing when directed by COR.

--- End of Section ---

**SECTION 01 56 39**  
**TEMPORARY TREE PROTECTION**

**PART 1 - GENERAL**

1.1 RELATED SECTIONS

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.
- B. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.2 DEFINITIONS

- A. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

1.3 PROHIBITED PRACTICE

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

**PART 2 - PRODUCTS**

2.1 PROTECTION-ZONE FENCING

Provide adequate chain-link fencing in order to protect tree(s).

**PART 3 - EXECUTION**

3.1 TREE PROTECTION ZONES

- A. Protection-Zone Fencing:

1. Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from entering protected area. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
  2. Posts: Provide concrete base acceptable to the COR.
- B. Protection-Zone Signage:
1. Install protection-zone signage in visibly prominent location in a manner approved by the COR.
  2. Install one sign spaced approximately every 20 feet on protection-zone fencing, but no fewer than signs with each facing a different direction.
- C. Maintenance of Protection Zones:
1. Maintain protection zones free of weeds and trash.
  2. Maintain protection-zone fencing and signage in good conditions as acceptable to the COR and remove when construction operations are complete and equipment has been removed from site. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.

### 3.2 EXCAVATION

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

--- End of Section---

**SECTION 01 57 19  
TEMPORARY ENVIRONMENTAL CONTROLS**

**PART 1 GENERAL**

1.1 PAYMENTS

No separate payment will be made for activities associated with environmental protection. Environment protection is an associated subsidiary obligation of the contract line items.

1.2 REGULATORY REQUIREMENTS

U.S. Code of Federal Regulations (CFR), 40: Protection of Environment

40 CFR 204        Noise Abatement Program for Construction Equipment

40 CFR 260        Hazardous Waste Management System: General

40 CFR 261        Identification and Listing of Hazardous Waste

40 CFR 262        Standards Applicable to Generators of Hazardous Waste

40 CFR 263        Standards Applicable to Transporters of Hazardous Waste

40 CFR 279        Standards for the Management of Used Oil

40 CFR 302        Designation, Reportable Quantities, and Notification

40 CFR 355        Emergency Planning and Notification

U.S. Code of Federal Regulations (CFR), 49: Transportation

49 CFR 100-199        Hazardous Materials Transportation, Handling and Storage  
Regulations

United States Code (U.S.C.)

7 U.S.C. §§ 136 to 139y    Insecticide, Fungicide, and Rodenticide Act

15 U.S.C. §§ 2601 to        2654    Toxic Substance Control Act

42 U.S.C. §§ 4901 to        4918    Noise Control Act

42 U.S.C. §§ 6901 to        6991i    Resource Conservation and Recovery Act (RCRA)

42 U.S.C. §§ 7401 to        7642    Clean Air Act

42 U.S.C. §§ 9601 to 9675        Comprehensive Environmental Response,

Compensation, and Liability Act (CERCLA)

State of California

CHSC

California Health and Safety Code

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

**3.1 TRAINING OF CONTRACTOR PERSONNEL**

- A. The Contractor's personnel shall be trained in all phases of environmental protection and pollution control.

--- End of Section ---

**SECTION 01 57 23  
TEMPORARY STORM WATER POLLUTION  
CONTROL**

**PART 1 GENERAL**

1.1 PAYMENTS

A. No separate payment will be made for activities associated with environmental protection.

1.2 REGULATORY REQUIREMENTS

A. DWQ CONSTRUCTION GENERAL

PERMIT [http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/constpermits.shtml](http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml)

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

3.1 GENERAL PERMIT FOR CONSTRUCTION

Obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ.

Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling, and excavation. Work shall not commence until meeting state requirements.

3.2 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

Continually update the SWPPP as regulations require and as needed to reflect current site conditions. Make SWPPP manual available to COR upon request.

3.3 BEST MANAGEMENT PRACTICES (BMP)

Implement Best Management Practices beyond minimum requirements.

--- End of Section ---

**SECTION 01 66 19  
MATERIAL AND EQUIPMENT**

**PART 1 GENERAL**

(Not Used.)

**PART 2 PRODUCT**

(Not Used.)

**PART 3 EXECUTION**

**3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's recommendations on product handling, storage, and protection.
  - a. Maintain packaged materials with seals unbroken and labels intact until time of use.
  - b. Promptly remove damaged materials and unsuitable items from the job site, and promptly replace with material meeting the specified requirements at no additional cost to the Government.
  
- B. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
  
- C. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.
  
- D. Maintain finished surfaces clean, unmarred, and suitable protected until accepted by the Government.
  
- E. Repairs and Replacements
  - 1. In event of damage before final acceptance, promptly make replacements and repairs to the satisfaction of, and at no cost to, the Government.
  - 2. Additional time required to secure replacements and to make repairs will not be considered by the Government to justify an extension in the Contract Time of Completion.

--End of Section--

**SECTION 01 71 23  
FIELD ENGINEERING**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Verification of lines and grades during construction.

1.2 SUBMITTALS

- A. Finish Lines and Elevations Certificate

**PART 2 PRODUCTS**

(Not Used)

**PART 3 EXECUTION**

3.1 LAYOUT OF WORK

- A. Furnish all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out all portions of the Work.
- B. Establish, maintain, and plainly mark lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for Work are in accordance with lines and elevations shown on contract drawings.
- C. Furnish Certificate from a California Registered Land Surveyor that finish lines and elevations of the Work are to grade and position.

--- End of Section ---

**SECTION 01 74 19  
CONSTRUCTION WASTE MANAGEMENT**

**PART 1 – GENERAL**

1.1 SUBMITTALS

- A. Construction Waste Management Plan
- B. Recycling Report

**PART 2 - PRODUCTS**

(Not Used.)

**PART 3 – EXECUTION**

3.1 Waste Diversion

- A. Waste disposal to landfills shall be minimized. Divert construction and demolition waste from landfills and incinerators, including:
  - 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.
- B. Ensure that facilities used for recycling, reuse, and disposal are permitted for the intended use to the extent required by local, state, federal regulations.
- C. 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.

- D. 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.

### 3.2 COLLECTION

- A. Provide 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.

### 3.3 RECYCLING 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 materials disposed and diverted from landfill disposal through salvage or recycling during the period with receiving parties, dates removed, transportation costs, weight tickets, manifests, and invoices.

- - - End of Section - - -

**SECTION 01 77 00  
CLOSEOUT PROCEDURES**

**PART 1 GENERAL**

**1.1 PAYMENT**

Separate payment will not be made for closeout procedures. Associated costs will be included in the most applicable Bid Schedule unit or lump-sum price.

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

**3.1 PUNCH-OUT INSPECTION**

Conduct inspection of the Work with COR prior to final acceptance, or at the conclusion of any increment Work to gain preliminary VA acceptance. Prepare a punch list of items that are deemed not to conform to the Contract. Include within the deficiency list the estimated date by which the deficiencies will be corrected. Confirm correction with the COR then notify the Government that the facility is ready for the Government Pre-Final inspection.

**3.2 PRE-FINAL INSPECTION**

Perform Pre-Final Inspection with VA to verify that the facility is complete and ready for use. A Government Pre-Final Punch List shall be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a final inspection with VA staff may be scheduled.

**3.3 FINAL ACCEPTANCE INSPECTION**

Schedule final acceptance inspection.

--- End of Section ---

**SECTION 01 78 23  
OPERATION AND MAINTENANCE DATA**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

01 78 36 WARRANTIES, 3.1 Warranty Information

1.2 SUBMITTALS

- A. Manufacturer's Operations and Maintenance (O&M) Manuals
- B. Spare Parts Data
- C. Wiring and Control Diagrams
- E. Maintenance/Repair Contact List

**PART 2 PRODUCTS**

2.1 O&M MANUALS

Complete information available from manufacturer for each equipment.

2.2 SPARE PARTS AND SUPPLY LISTS

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. List spare parts and supplies that have a long lead-time to obtain. Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that are standard to normal maintenance.

2.3 WIRING DIAGRAMS AND CONTROL DIAGRAMS

Submittal for Wiring and Control Diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide complete and accurate depiction of Work as installed.

2.4 MAINTENANCE/REPAIR CONTACT LIST

For each item, provide:

- A. Name address and telephone number of local manufacturer's representative and service organizations.
- B. Name, address, and telephone number of product, equipment, and system manufacturers.

## **PART 3 EXECUTION**

### **3.1 O&M SUBMISSION**

No equipment or machinery shall be delivered or installed without Products Operations and Maintenance data submittal approval.

### **3.2 TRAINING**

Instruct VA personal on use and maintenance for each equipment installed; instruct until acknowledgement of understanding by VA staff present.

--- End of Section ---

**SECTION 01 78 29  
FINAL SITE SURVEY**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

- A. 017419 CONSTRUCTION WASTE MANAGEMENT, Waste Management Plan.

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

3.1 CLEANUP

- A. Prior to final acceptance:

1. Remove signs of temporary construction facilities
2. Remove construction materials
3. Disturbed exterior surroundings shall be graded, filled, and entire area seeded unless otherwise indicated.
4. Clean equipment, fixtures, and surfaces
5. Remove dust, dirt, stains, foreign substances, and temporary labels
6. Sweep paved areas and rake clean landscaped areas
7. Remove waste and rubbish from Site.
8. Recycle, salvage, and return construction and demolition waste from project in accordance with the Waste Management Plan.
9. Promptly and legally transport and dispose of any trash.

--- End of Section ---

**SECTION 01 78 36  
WARRANTIES**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

00 72 00 GENERAL CONDITIONS, 48 CFR 52.246-21, Warranty of Construction

1.2 SUBMITTALS

A. Warranty Information

**PART 2 PRODUCTS**

(Not Used.)

**PART 3 EXECUTION**

3.1 WARRANTY INFORMATION

Provide:

- A. Provide warranty information for each equipment, item, feature of construction including but not limited to:
1. Name of item.
  2. Model and serial numbers.
  3. Location where installed.
  4. Name and phone numbers of manufacturers or suppliers.
  5. Names, addresses, and telephone numbers of sources of spare parts.
  6. Warranty period durations, and starting and expiration dates.
  7. Cross-reference to warranty certificates as applicable.
  8. Summary of maintenance procedures required to keep warranty in force.
  9. Pertinent Operation and Maintenance manuals.
  10. Organization, names, and phone numbers of persons to call for warranty service.
- B. Warranty Information for each installed equipment must be satisfactorily submitted before next progress payment following installation will be approved.

3.2 WARRANTY PERIOD SERVICES

- A. A joint 4-month and 9-month warranty inspection shall be conducted, measured from time of Project final acceptance. Set meetings with VA.

--End of Section --

**SECTION 01 78 39  
PROJECT RECORD DOCUMENTS**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Record drawings that document progress and final as-built project conditions, and list of equipment as installed.

1.2 SUBMITTALS

- A. Completion of Phase Record Drawings
- B. Final Record Drawings

1.3 COMPUTER AIDED DESIGN AND DRAFTING (CADD) DRAWING CAPABILITIES

Only employ personnel proficient in preparation of CADD drawings to modify Contract drawings, record as-built conditions, or prepare additional new drawings.

1.4 PAYMENT

No separate payment will be made for record drawings required under this contract, and costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

**PART 2 PRODUCTS**

2.1 WORKING AND FINAL RECORD DRAWINGS

- A. Changes from Contract plans that are made in the Work shall be accurately and neatly recorded in the record drawings as they occur.
- B. Additions and corrections to the Contract drawings shall be equal in quality and detail to that of the originals. Meet line colors, line weights, lettering, layering conventions, and symbols must be the same as the original line colors, line weights, lettering, layering conventions, and symbols.
- C. Title block and drawing border to be used for final record drawings must be identical to that used on the Contract drawings.
- D. Provide CADD "base" colors of red, green, and blue. Color code for changes as follows:

1. Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.
  2. Additions (Green) - Added items, lettering in notes and leaders.
  3. Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.
- E. Include:
1. Location of utilities.
  2. Location and dimensions of any changes to Work.
  3. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures, or utilities if any changes were made or found from contract plans.
  4. Changes in details of design or additional information obtained from working drawings including, but not limited to, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, and dimensions of equipment foundations.
  5. Additional existing condition information uncovered in the course of construction.
  6. Topography, invert elevations, and grades of drainage installed or affected as part of Project construction.
  7. Where contract drawings or specifications present options, show only the option selected for construction on final as-built prints.
  8. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of final borrow pit/spoil area elevations.
- F. When final revisions have been completed, show the wording "AS-BUILT" followed by name of the Contractor on cover sheet drawing.

### **PART 3 EXECUTION**

#### **3.1 PROJECT RECORD DRAWINGS**

- A. Provide "as-designed" drawings. The electronic files shall be supplied on compact disc, read-only memory (CD-ROM). Provide program files and hardware necessary to prepare working and final record drawings in AutoCad 2014 or

above.

- C. As-Built at the End of Each Phase: Update record (as-built) drawings in AutoCAD after the completion of each definable feature of Work. Submit electronic and hardcopy print in half-size after each phase of Work.
- D. Final Record Drawings: Within 20 days after Government approval of final Work, prepare the final CADD record drawings and submit an electronic copy, two full-size, and two half-size sets of printed drawings for Government review and approval. Approval and acceptance of final record drawings must be accomplished before final payment is made.

--- End of Section ---

## **SECTION 02 41 00 DEMOLITION**

### **PART 1 - GENERAL**

#### 1.1 SECTION INCLUDES

- A. Demolition and removal of buildings, portions of buildings, utilities, other structures.

#### 1.2 RELATED SESSIONS

- A. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- B. Construction Waste Management: Section 017419 CONSTRUCTION WASTE MANAGEMENT.

### **PART 2 - PRODUCTS**

(Not Used.)

### **PART 3 - EXECUTION**

#### 3.1 DEMOLITION

- A. Completely demolish and remove buildings and structures, including:
  - 1. As required for installation of new utility service lines.
  - 2. To full depth within an area defined by lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on Drawings, the COR shall be notified prior to further work in that area.
- C. 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.

#### 3.2 PROTECTION

- A. 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 Work area daily.
- B. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

- C. Before beginning any demolition work, survey Site and examine Drawings and specifications to determine extent of Work. Take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain property of the VA.

--- End of Section ---

**SECTION 03 10 00**  
**CONCRETE FORMS AND ACCESSORIES**

**PART 1 GENERAL**

**1.1 REFERENCES**

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

A. American Concrete Institute (ACI):

117R-06 Tolerances for Concrete Construction and Materials  
318-08 Building Code Requirements for Reinforced Concrete  
347-04 Guide to Formwork for Concrete  
SP-66-04 ACI Detailing Manual

B. American National Standards Institute and American Hardboard Association  
(ANSI/AHA):

A135.4-2004 Basic Hardboard

C. American Society for Testing and Materials (ASTM):

C309-07 Liquid Membrane Forming Compounds for Curing Concrete  
C881/C881M-02 Epoxy-Resin-Base Bonding Systems for Concrete  
C1107/1107M-08 Packaged Dry, Hydraulic-Cement Grout (Non-shrink)  
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

D. U. S. Department of Commerce Product Standard (PS):

PS 20 American Softwood Lumber

E. U. S. Army Corps of Engineers Handbook for Concrete and Cement:

CRD C513 Rubber Waterstops  
CRD C572 Polyvinyl Chloride Waterstops

F. California Department of Transportation (CALTRANS)

Caltrans Standard Specifications

**1.2 SUBMITTALS**

A. Land Surveyor Certification

### 1.3 TOLERANCES

- A. Formwork: ACI 117, except elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).

## PART 2 PRODUCTS

### 2.1 FORMS

- A. Wood: PS 20 free from loose knots and suitable to facilitate finishing concrete surface specified; tongue and grooved.
- B. Plywood: PS-1 Exterior Grade B-B (concrete-form) 16 mm (5/8 inch), or 20 mm (3/4 inch) thick for unlined contact form. B-B High Density Concrete Form Overlay optional.
- C. Metal for Concrete Rib-Type Construction: Steel (removal type) of suitable weight and form to provide required rigidity.
- D. Permanent Steel Form for Concrete Slabs: Corrugated, ASTM A653, Grade E, and Galvanized, ASTM A653, G90. Provide venting where insulating concrete fill is used.
- E. Form Lining:
  - 1. Hardboard: ANSI/AHA A135.4, Class 2 with one (S1S) smooth side)
  - 2. Plywood: Grade B-B Exterior (concrete-form) not less than 6 mm (1/4 inch) thick.
  - 3. Plastic, fiberglass, or elastomeric capable of reproducing desired pattern or texture.
- F. Form Ties: Develop a minimum working strength of 13.35 kN (3000 pounds) when fully assembled. Ties shall be adjustable in length to permit tightening of forms and not have any lugs, cones, washers to act as spreader within form, nor leave a hole larger than 20 mm (3/4 inch) diameter, or a depression in exposed concrete surface, or leave metal closer than 40 mm (1 1/2 inches) to concrete surface. Wire ties not permitted. Cutting ties back from concrete face not permitted.
- G. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil)
- K. Supports, Spacers, and Chairs: 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.

## PART 3 EXECUTION

### 3.1 FORMWORK

- A. Formwork installations shall conform to ACI 347.
- B. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating concrete.

- C. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (10 foot) long section, in either a horizontal or vertical direction.
- D. 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.

### 3.2 SETTING FORMS

- A. Set forms sufficiently in advance of placing of concrete to permit performance and approval of operations required.
- B. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that forms and joints are free from play or movement in any direction.
- C. 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.
- D. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
- E. Clean and oil forms each time they are used.
- F. The Contractor's registered professional land surveyor shall establish and control alignment and grade elevations of forms or concrete slipforming machine operations. Submit certification that grades are correct.
- G. Make necessary corrections to forms immediately before placing concrete.
- H. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck form before placing concrete.

### 3.3 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after concrete has been placed. Remove forms without injuring concrete.
- B. Do not use bars or heavy tools against concrete in removing forms. Promptly repair any concrete found defective after form removal.

- - - End of Section - - -

**SECTION 03 20 00  
CONCRETE REINFORCEMENT**

**PART 1 GENERAL**

**1.1 REFERENCES**

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

A. American Association of State Highway and Transportation Officials (AASHTO):

M31 Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)

M42 Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.

M55M/55M Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)

B. American Concrete Institute (ACI):

117-10 Tolerances for Concrete Construction and Materials

301-10 Structural Concrete

318-08 Building Code Requirements for Reinforced Concrete and Commentary

SP-66-04 ACI Detailing Manual

C. 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

A775/A775M Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b

D. American Welding Society (AWS):

D1.4/D1.4M-11 Structural Welding Code Reinforcing Steel

E. Concrete Reinforcing Steel Institute (CRSI):

Handbook 2008

F. California Department of Transportation (CALTRANS)

Caltrans Standard Specifications

## 1.2 SUBMITTALS

- A. Shop Drawings
- B. Mill Test Reports

## **PART 2 PRODUCTS**

### 2.1 REINFORCING STEEL: Conforming to ASTM A615.

- A. #3 and smaller: Grade 40.
- B. #4 and larger: Grade 60.

### 2.2 EPOXY-COATED REINFORCEMENT BARS

- A. Shall be in accordance with ASTM A775/A775M
- B. Shall be fabricated and handled in accordance with ASTM D3963/D3963M.

### 2.3 WELDED WIRE FABRIC: Conforming to ASTM A185, AASHTO M55.

### 2.4 REINFORCING BARS TO BE WELDED: conforming to ASTM A706.

### 2.5 DOWELS: Plain steel, conforming to AASHTO M31/M42.

### 2.6 TIE BARS: Deformed steel, conforming to AASHTO M31/M42.

## **PART 3 EXECUTION**

### 3.1 PLACING REINFORCEMENT

- A. General: ACI 318, unless otherwise shown.
- B. Placing: CRSI DA4, unless otherwise shown.
- C. Shop Drawings: ACI SP-66. Include bar sizes, material types, lengths, spacings, locations, and quantities of reinforcing steel; bar schedules, stirrup spacing, shapes of bent bars, spacing of bars, and types and location of splices.
- D. Welded Splices, Chemical Analysis: AWS D1.4.
- E. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength ( $f_y$ ) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and threaded sleeve. Exposed threads and swaging in the field not permitted.
  - 1. Provide field quality control procedure to insure proper inspection, materials, and welding procedure for welded splices.
  - 2. In the presence of the COR, make three test mechanical splices of each bar size proposed to be spliced.
- F. Perform tension tests of mechanical and welded splices: ASTM A370.

- - - End of Section - - -

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

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Pedestrian Pavement: Patios, walks, lawn mower strips, crossings, wheelchair curb ramps, terraces, and steps
- B. Concrete work for footings

1.2 RELATED SECTIONS

- A. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- B. 32 11 36 CONCRETE BASE COURSES
- C. 03 10 00 CONCRETE FORMS AND ACCESSORIES
- D. 03 20 00 CONCRETE REINFORCEMENT
- E. 03 35 00 CONCRETE FINISHING
- F. 03 39 00 CONCRETE CURING

1.3 REFERENCES

Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only. Latest version at time of award shall apply:

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - M213-01-UL Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
  - M233-86-UL Boiled Linseed Oil Mixer for Treatment of Portland Cement Concrete
  - M182/M213 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
- B. American Concrete Institute (ACI):
  - 117 Tolerances for Concrete Construction and Materials
  - 211.1 Selecting Proportions for Normal, Heavyweight, and Mass Concrete
  - 211.2 Selecting Proportions for Structural Lightweight Concrete

- 301 Structural Concrete
- 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
- 318 Building Code Requirements for Reinforced Concrete
- SP-66 ACI Detailing Manual

C. American Society for Testing and Materials (ASTM):

- C31/C31M Making and Curing Concrete Test Specimens in the field
- C33 Concrete Aggregates
- C39/C39M Compressive Strength of Cylindrical Concrete Specimens
- C94/C94M Ready-Mixed Concrete
- C143/C143M Slump of Hydraulic Cement Concrete
- C150 Portland Cement
- C172 Sampling Freshly Mixed Concrete
- C173 Air Content of Freshly Mixed Concrete by the Volumetric Method
- C192/C192M Making and Curing Concrete Test Specimens in the Laboratory
- C260 Air-Entraining Admixtures for Concrete
- C494/C494M Chemical Admixtures for Concrete
- C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C881/C881M Epoxy-Resin-Base Bonding Systems for Concrete
- C1107/1107M Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
- D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- E1155 Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers

D. California Department of Transportation (CALTRANS) Standard Specifications:

- Section 90 Portland Cement Concrete. 4-9001 General

E. U. S. Army Corps of Engineers Handbook for Concrete and Cement:

CRD C513 Rubber Waterstops

CRD C572 Polyvinyl Chloride Waterstops

1.4 SUBMITTALS

A. Concrete Mix Design: Submit for each type and strength of concrete.

1. Include unit weight, slump, water-cement fly ash ratio curves, concrete mix ingredients, admixtures and compression test reports. Results of testing or test data used to establish mix proportions are to be provided for each mix design.
2. Mix designs to be prepared, stamped, and signed by a Professional Engineer registered in the State of California.

B. Data and Test Reports

1. Select subbase material
  - a. Job-mix formula
  - b. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

B. Mill Test Reports

1. Reinforcing Steel
2. Cement

C. Manufacturer's Certificates

1. Chemical admixtures, including chloride ion content
2. Non-shrinking grout
3. Liquid hardener
4. Waterstops
5. Expansion joint filler
6. Adhesive binder
7. Hot poured sealing compound

D. Samples and Mockups

1. Full-scale mock-up (minimum 4-foot by 4-foot) sample panels of concrete paving finishes and color, subject to approval by the COR. Samples shall include curing compound if any is to be used, and include example of expansion joints, both with and without sealant, and a score joint, as indicated in drawings.
2. Caulking – submit samples colored to match adjacent paving.
3. Full scale mock-up of Glass Water Feature base edge condition (minimum 5-foot length by 3-foot width) including any curing compound, admixtures, and form release

- agents that are to be used, and include edge profile, reinforcing, face texturing, finishes, and color as indicated in drawings.
4. Provide mock-ups as necessary to achieve satisfactory results in finishing/textures/color, subject to approval by the COR.
  5. Mock ups shall be constructed at the project site and available for review by the COR in time to allow time for mix design revision as necessary to achieve color and finish matching existing concrete paving. Approved samples shall be kept at the job site to serve as a prerequisite for finishes until acceptance of the Work.

### 1.5 TOLERANCES

- C. Cross-Sectional Tolerances: 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).
- D. Slab Finishes: ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155, except as follows:
  1. Test entire slab surface, including those areas within 600 mm (2 feet) of construction joints and vertical elements that project through slab surface.
  2. Maximum elevation change which may occur within 600 mm (2 feet) of any column or wall element is 6 mm (0.25 inches).
  3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 1500 mm (5 feet).

### 3.10 WEATHER MODIFICATIONS

- A. Hot weather: Modify mixes according ACI 305.
- B. Cold weather: Modify mixes according to ACI 306. Calcium chloride, thiocyanates, or admixtures containing more than 0.05 percent chloride ions shall not be used.

## PART 2 PRODUCTS

### 2.1 CONCRETE

- 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 alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Aggregate: ASTM C33
- 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 requirements above and chloride ion content of admixture prior to mix design review.
- G. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil)
- H. Supports, Spacers, and Chairs: ACI 318 except as specified.
- I. Expansion Joint Filler: ASTM D1751
- J. Abrasive Aggregate: Aluminum oxide grains or emery grits.
- K. 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 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 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.
- L. 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 designated sample panel.

## 2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type II. Use one brand of cement throughout project.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Aggregates: ASTM C33, materials from established sources with proven history of successful use in producing concrete with minimum shrinkage. Course Aggregate to be Size 67.
- D. Admixtures:
  - 1. Use as needed to achieve design intent of Drawings and prevent honeycombing, bug holes, rock pockets, voids, spalling, or other deficiencies. However, a water reducer or plasticizing admixture shall be included in concrete mix.
  - 2. Any proposed admixture shall comply with ASTM C494.
  - 3. Where more than one admixture is proposed, include statement from admixture manufacturer indicating that admixtures proposed for use are compatible, such that desirable effects of each admixture will be realized.
  - 4. Accelerating admixtures and admixtures containing more than 0.05 percent chloride ions are not permitted. If an accelerator is used, it shall be a non-chloride accelerator.
  - 5. Admixtures must be compatible with color pigments where color pigments are used.

## 2.2 GENERAL

- A. Cement and aggregates shall have proven history of successful use with one another. Sources of cement and aggregate shall remain unchanged throughout work.
- B. Mixes:
  - 1. Ready-mixed concrete shall meet requirements of ASTM C94.
  - 2. Perform tests or assemble necessary data indicating conformance with Specifications.
  - 3. For each mix, submit data showing that proposed mix will attain required strength in accordance with requirements of Caltrans Standard Specifications, Section 90.
  - 4. Instruct Laboratory to base mix design on use of materials specified and approved by the COR.
  - 5. If mix yield exceeds 1-cubic yard, modify mix design to no more than one cubic yard, without changing cement content.

6. Introduction of calcium chloride will not be permitted.
  7. Mix design shall match appearance of existing site concrete, subject to approval by the COR.
- C. Concrete Types (See Drawings for any other miscellaneous items not listed below):

TYPE	28-DAY STRENGTH	AGGREGATE SIZE	FINISH & COLOR	COMMENTS
Integral Color Concrete Slabs and Pavement	3,000	1" X #4	Davis Color 'Pebble' per campus standard; Light sandblast	
Natural Grey Concrete Slabs and Pavement	3,000	1" X #4	Light sandblast	

## 2.3 EXPANSION JOINT FILLERS

- A. Material shall conform to AASHTO M213.

## PART 3 EXECUTION

### 3.1 CONCRETE MIXES

- A. Mix Designs: 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 proportions of trial mix or mixes, including fly ash, cement, admixtures, weight of fine and coarse aggregate per m<sup>3</sup> (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. Show relationship between water-cement ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
  4. If field experience method is used, submit standard deviation analysis.
- B. Cement and Fly Ash Testing: Submit certificate verifying conformance with specifications. Notify the COR immediately when change in source is anticipated. Prior to beginning trial mixes, submit to the COR representative samples of material to be used.
1. Portland cement - 3.5 kg (8 pounds)

- 2. Fly ash – 2.25 kg (5 pounds)
- 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 the COR.
- 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 percent replacement by weight in 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 <sup>3</sup> (pounds/cubic yard)	Max. Water Cement Ratio (percent)	Min. Cement kg/m <sup>3</sup> (pounds/cubic yard)	Max. Water Cement Ratio (percent)
35 (5000) <sup>1,3</sup>	375 (630)	0.45	385 (650)	0.40
30 (4000) <sup>1,3</sup>	325 (550)	0.55	340 (570)	0.50
25 (3000) <sup>1,3</sup>	280 (470)	0.65	290 (490)	0.55
25 (3000) <sup>1,2</sup>	300 (500)	*	310 (520)	*

- 1. If trial mixes are used, 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), 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. Concrete to be vibrated shall have maximum slump 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)

\*Slump may be increased by use of approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing high-range-water-reducing admixture may have a maximum slump of 225 mm (9 inches). 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.

- F. 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 safety of the structure, the COR 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, The COR may order load tests, made by Contractor retained testing agency and to be paid for by the Contractor. Load tests in accordance with ACI.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or not meeting other provisions of these specifications, shall be replaced.

### 3.2 SELECT MATERIAL JOB-MIX

- A. Retain and reimburse a testing laboratory to design mix and submit a job-mix formula to the COR. Formula shall include source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.
- B. Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94. Batch mixing at the site is permitted. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94.

### 3.5 PLACING CONCRETE

- A. Obtain approval of the COR before commencement of placing concrete.
- B. Remove debris and other foreign material from between forms before placing concrete.
- C. Consolidation: Conform to ACI 309.
- D. Install a construction joint whenever placing of concrete is suspended for more than 30 minutes and at end of each day's work.

### 3.5 JOINTS - GENERAL

- A. Place joints where shown, conforming to details as shown, and perpendicular to finished grade of concrete surface.
- A. Joints shall be straight and continuous from edge to edge of pavement.

### 3.6 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 required width and depth.
- B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to cross sections of 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 joint edges with an edging tool having radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

### 3.7 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of thickness as shown to form expansion joints.

- B. Material shall extend full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round joint edges with an edging tool.
- E. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.
- F. Using joint filler of type, thickness, and width as shown.

### 3.8 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown.
- B. Place transverse construction joints of type shown, where indicated, and whenever placing of concrete is suspended for more than 30 minutes.
- C. Use a butt-type joint with dowels in curb and gutter if joint occurs at location of a planned joint.
- D. Use keyed joints with tie-bars if joint occurs in middle third of normal curb and gutter joint interval.

### 3.9 PROTECTION

- A. Remove concrete containing excessive cracking, fractures, spalling, or other defects, and reconstruct entire section between regularly scheduled joints, when directed by the COR, and at no additional cost to the Government.

### 3.11 PATCHING

- A. Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.

### 3.16 CONCRETE MOCK-UP

- A. Provide full-scale mock-up of colored concrete sidewalk for review by the COR.  
Construct at least one month before start of other concrete work to allow concrete to cure before observation.
- B. At location on Project selected by the COR, demonstrate each forming and finishing condition technique to be used, using materials, workmanship, joint treatment, form ties, curing method, and patching techniques.
- C. Retain samples of cements and aggregates used in mock-up for comparison with materials used in remaining Work.
- D. Remove mock-up when directed by COR.

- - - End of Section - - -

**SECTION 03 35 00  
CONCRETE FINISHING**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

- A. 03 30 00 CAST IN PLACE CONCRETE

1.2 REFERENCES

- A. American Concrete Institute (ACI):
  - SP-66 ACI Detailing Manual
- B. American Society for Testing and Materials (ASTM):
  - C979 Standard Specification for Pigments for Integrally Colored Concrete
- C. Caltrans Standards Specifications
  - Section 51-1.03D(5)
  - Section 90

1.3 SUBMITTALS

- A. Manufacturer's Certificates
  - 1. Pigments

**PART 2 PRODUCTS**

2.1 COLOR ADDITIVES

- A. Color Additives/Pigments: Insoluble materials, light fast, at least 95 percent passing #325 sieve complying with ASTM C979: Davis Colors, manufactured by Davis Colors, Los Angeles, CA, Mix-Ready Pebble, or approved equal.
  - 1. Davis 641 "Pebble" at 0.5 pounds per 94-pound sack of cement for powder.
  - 2. Davis 641 "Pebble" at 0.76 pounds per 94-pound sack of cement for liquid.
- B. Color additives containing carbon black are not acceptable.

**PART 3 EXECUTION**

3.5 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Brooming shall be transverse to line of traffic.

- B. Finish slab edges, including those at formed joints, with an edger having a radius as shown on Drawings.
- C. Unless otherwise indicated, edge transverse joints before brooming. Brooming shall eliminate the flat surface left by the surface face of the edger. Execute brooming so that corrugation will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
- D. Completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. Finished surface shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
- E. Pavement thickness shall not vary more than 6 mm (1/4 inch).
- F. Steps: Method of finishing steps and sidewalls is similar to above except:
  - 1. Remove riser forms one at a time, starting with top riser.
  - 2. After removing riser form, rub face of riser with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Use an outside edger to round the corner of tread; use an inside edger to finish corner at bottom of the riser.
  - 3. Give risers and sidewall a final brush finish. Treads shall have a final finish with a stiff brush to provide a non-slip surface.
  - 4. Texture of completed steps shall present a neat and uniform appearance and shall not deviate from a straightedge test more than 5 mm (3/16 inch).

### 3.6 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

- A. Provide longitudinal floating with a longitudinal float not less than 3000 mm (10 feet) long and 150 mm (6 inches) wide, properly stiffened to prevent flexing and warping.
- B. After longitudinal floating is completed, but while concrete is still plastic, eliminate minor irregularities in pavement surfaces by means of metal floats, 1500 mm (5 feet) in length, and straightedges, 3000 mm (10 feet) in length. Make final finish with straightedges, which shall be used to float the entire pavement surface.
- C. Test surface for trueness with a 3000 mm (10 foot) straightedge held in successive positions parallel and at right angles to direction in which pavement is being laid and entire area covered as necessary to detect variations. Advance straightedge along pavement in successive stages of not more than one half the length of the straightedge. Correct irregularities and refinish surface.
- D. Finished pavement surface shall not vary more than 6 mm (1/4 inch) in both longitudinal and transverse directions when tested with a 3000 mm (10 foot) straightedge.
- E. Thickness of pavement shall not vary more than 6 mm (1/4 inch).
- F. When most of the water glaze or sheen has disappeared and before concrete becomes nonplastic, give pavement surface a broomed finish with an approved fiber broom not less than 450 mm (18 inches) wide. Pull broom gently over surface from edge to edge. Brooming shall be transverse to line of traffic and so executed that corrugations thus produced will be uniform in character and width, and not more than 3 mm (1/8 inch) in depth. Carefully finish the pavement edge along forms and at the

joints with an edging tool. Brooming shall eliminate the flat surface left by the surface face of the edger.

- G. Finish surfaces of new and existing abutting pavements shall coincide at their juncture.

### 3.7 CONCRETE FINISHING EQUIPMENT PADS

- A. After surface has been struck off and screeded to proper elevation, give it a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish slab edges with an edger having a radius as shown on Drawings.
- C. After removing forms, rub the pad faces with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Finish surface of pad shall not vary more than 3 mm (1/8 inch) when tested with a 3000 mm (10 foot) straightedge.
- D. Correct irregularities.

### 3.11 PATCHING

- A. Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.
- B. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

### 3.12 VERTICLE SURFACE FINISHES

- A. After concrete has hardened and laitance, fins, and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.

- B. Apply grout composed of one part of Portland cement, one part fine sand, smaller than a 600  $\mu\text{m}$  (No. 30) sieve. Work grout into surface of concrete with cork floats or fiber brushes until pits and honeycombs are filled.
- C. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about 1 hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
- D. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.
- E. Maximum quantity of patched area 0.2  $\text{m}^2$  (2 square feet) in each 93  $\text{m}^2$  (1000 square feet) of textured surface.

### 3.13 FINISHES FOR GLASS WATER FEATURE BASE

- A. Form-liner finish: Provide form liner to achieve texture per drawings
- B. Steel Trowel Finish (top): After surface water disappears and floated surfaces sufficiently hardened, steel trowel and retrowel to smooth surface. After concrete has set enough to ring trowel, retrowel to a smooth uniform finish free of trowel marks or other blemishes. Avoid excessive troweling that produces burnished areas.

### 3.14 FINISHES FOR FLATWORK (PEDESTRIAN)

- A. Sandblast Finish: Perform in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish.
  - 1. Use an abrasive grit of proper type and gradation to expose the aggregate and surrounding matrix surfaces to match sample panel, as follows:
    - a. Light Cut: Approximately 1/16 inch depth
    - b. Medium Cut: approximately 1/8 to 3/16 inch depth
    - c. Heavy Cut: approximately 1/4 to 5/16 inch depth
  - 2. Blast corners and edge of patterns carefully, using backup boards in order to maintain a uniform corner of edge line.
  - 3. Use same nozzle, nozzle pressure and blasting technique as used for sample panel.
  - 4. Maintain control of abrasive grit and concrete dust in each area of blasting. Clean up and remove expended abrasive grit, concrete dust, and debris at the end of each day of blasting operations.

### 3.15 FINISHES FOR SUB-SLABS

- A. Medium Broom Finish: Obtain by drawing a stiff bristled broom across a floated finish for a nonslip surface. Perform brooming while concrete is still wet enough to receive broom marks to match approved sample. Direction of brooming to be perpendicular to direction of work or as otherwise shown on Drawings.

### 3.16 SLAB FINISHES

- A. 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 structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores.
- B. 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 the COR 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 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.
- C. 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.
- D. 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 surface.
- E. 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.
- F. 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.
- G. Scratch Finish: Finish base slab to receive a bonded applied cementitious application as indicated above, except that bull floats and darbys may be used. Thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.
- H. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 3000 mm (10 foot) highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
- I. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight

angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.

- J. 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 the COR from sample panel.

### 3.13 SURFACE TREATMENTS

- A. Liquid Densifier/Sealer: Apply in accordance with manufacturer's directions just prior to completion of construction.
- B. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface at rate of application of 8 percent per 1/10th m<sup>2</sup> (7.5 percent per square foot) of area. Trowel concrete surface to smooth dense finish. After curing, rub treated surface with abrasive brick and water to slightly expose abrasive aggregate.

### 3.14 MIXING AND PLACING INTEGRALLY COLORED CONCRETE

- A. Conform to applicable requirements set forth in Caltrans Standards Specifications, Section 51-1.03D(5) and Section 90.
- B. Mixes for integrally colored concrete shall have pigment added early enough to ensure complete dispersal and uniform color, but not less than 15 minutes before placing.

- - - End of Section - - -

**SECTION 03 39 00  
CONCRETE CURING**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

- A. Section 03 30 00, CAST-IN-PLACE-CONCRETE

1.2 REFERENCES

The latest version at time of Contract award shall apply:

A. American Concrete Institute (ACI):

- 305 R-10 Guide to Hot Weather Concreting
- 306R Guide to Cold Weather Concreting
- 308R Guide to External Curing of Concrete
- 318 Building Code Requirements for Reinforced Concrete and Commentary
- SP-66 ACI Detailing Manual

B. American Society for Testing and Materials (ASTM):

- C171 Sheet Materials for Curing Concrete
- C309 Liquid Membrane Forming Compounds for Curing Concrete
- D4397 Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

C. American Association of State Highway and Transportation Officials (AASHTO):

- M148 Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
- M171 Sheet Materials for Curing Concrete (ASTM C171)
- M182 Burlap Cloth Made from Jute or Kenaf and Cotton Mats

D. California Department of Transportation (CALTRANS)

Caltrans Standard Specifications

1.7 SUBMITTALS

A. Manufacturer's Certificates

1. Waterproof paper for curing concrete
3. Liquid membrane-forming compounds for curing concrete

## **PART 2 PRODUCTS**

2.1 VAPOR BARRIER: ASTM D4397, 0.25 mm (10 mil)

2.2 SHEET MATERIALS FOR CURING CONCRETE: ASTM C171

2.3 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.

2.4 BURLAP: AASHTO M182, having a weight of 233 grams (seven ounces) or more per square meter (square yard) when dry.

### **2.1 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: "W 1000" by Davis Colors, Los Angeles, CA (800) 356-4848; or equal.

## **PART 3 EXECUTION**

### **3.1 WEATHER LIMITATIONS**

- A. Curing of concrete shall adjusted for weather as prescribed in ACI 305 and ACI 306.

### **3.2 CURING OF CONCRETE**

- A. Cure concrete by one of the following methods appropriate to weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from beginning of curing operation. Protect unhardened concrete from rain and flowing water. Equipment needed for adequate curing and protection of concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of pavement due to temperature changes during curing period. If selected method of curing does not afford proper curing and protection against concrete cracking, remove and replace damaged pavement and employ another method of curing as directed by the COR.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for 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 entire exposed concrete surface with a fine spray of water and then cover with sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). 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 5 m<sup>2</sup>/L (200 square feet per gallon) for both coats.
  - 2. Do not allow concrete to dry before 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 curing compound, in a manner to prevent curing compound entering the joint.
  4. Immediately re-spray any area covered with curing compound and damaged during curing period.
- E. Curing for Integrally Colored Concrete:
1. Cure colored exposed concrete using Curing Compound for Integrally Colored Concrete as specified herein.
  2. When applying curing compound, apply after initial set of fresh concrete when bleed water has evaporated from surface using a "Hudson-type" airless sprayer in accordance with manufacturer's specifications.
  3. Only water or curing compounds which impart no permanent color or gloss shall be used for curing integrally colored concrete.
- F. Conform to ACI 308.

- - - End of Section - - -

**SECTION 04 72 00  
STONE VENEER WALL**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Stone veneer using natural stone.

1.2 RELATED WORK

- B. Section 03 30 00, Cast in Place Concrete
- C. Section 31 20 00, Earthwork for foundation

1.3 SUBMITTALS

- A. Samples:
  - 1. Stone Samples
    - a. Stone Veneer 3 inches by 5 inches by 12 inches, two each color & finish.
    - b. End Cap, one top end cap full size
    - c. Top Cap, one full size top cap 6 inches long
- B. Shop Drawings:
  - 1. Stone veneer walls showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing, and sizes.
  - 2. Wall Cross sections including stone, concrete stem wall, footing, and reinforcing.
- C. List of at least three jobs by stone manufacturer, which were similar in size and scope, and completed within the past three years. Provide brief description, contact name and phone number for each project.
- D. Qualification for site supervisor.

1.4 WARRANTY

Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be two years from date of acceptance.

1.5 REFERENCES

American Society for Testing and Materials (ASTM):

C5-10	Standard Specification for Quicklime for Structural Purposes
C144-11	Standard Specification for Aggregate for Masonry
C150-16e1	Standard Specification for Portland Cement
C207-06(2011)	Standard Specification for Hydrated Lime for Masonry Purposes
C270-14a	Standard Specification for Mortar for Unit Masonry
C595-16	Standard Specification for Blended Hydraulic Cements
A615-16	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

1.6 QUALITY ASSURANCE

- A. Manufacturer:

1. 5 years minimum continuous operating experience and have facilities for manufacturing stone as described herein. Manufacturer shall have sufficient plant facilities to produce shapes, quantities and size of cast stone required in accordance with the project schedule.
  - B. Pre-installation Conference: Conduct conference at Project site with COR.
  - C. Installer Qualifications:
    1. Firm specializing in design and installation of stone walls
    2. Not less than 3 years documented experience.
    3. Minimum of five previously constructed successful projects, similar in size and magnitude, using specified wall system; Provide brief descriptions, contact names and numbers.
    4. Site supervisor with verifiable qualified experience suitable for this project.
- 1.7 MANUFACTURING TOLERANCES
- A. Cross section dimensions: +/- 1/8 in. (3 mm).
  - B. Length of units: length /360 or +/- 1/8 in. (3mm), whichever is greater, not to exceed +/- 1/4 in (6 mm). Maximum length of any unit shall not exceed 15 times average thickness.
  - C. Warp bow or twist of units shall not exceed length/360 or +/- 1/8 in. (3 mm), whichever is greater.
  - D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features:
    1. Sawn sides of unit: +/- 1/8 inch (3 mm)
    2. Unformed sides of unit, +/- 3/8 inch (9 mm)

## **PART 2 - PRODUCTS**

### **2.1 STONE VENEER WALL SOLID STONE UNITS**

- A. Natural stone quarried and sawn (except for face) into rectangular shapes and sizes suitable for wall configuration as shown.
  1. Stone Type: Lueders Limestone
  2. Colors:
    - a. "Chocolate" or approved equal in medium to dark brown tones
    - b. "Caramel" or approved equal in light brown or khaki tones
    - c. Veneer to be 2/3 "Chocolate" and 1/3 "Caramel"
    - d. Cap to be "Chocolate"
  3. Texture: As shown on Drawings.
  4. Face Shape: As shown on Drawings.
  5. Individual Stone Height: As shown on Drawings.
  6. Individual Stone Length (face Width): As shown on Drawings.
  7. Width (Depth from Face): As shown on Drawings.
  8. Moisture Absorption: 3 percent, maximum
- B. Appearance: Natural quarried or cut face without machine marks or scrapes

### **2.2 PORTLAND CEMENT**

- A. ASTM C150, TYPE I.

### **2.3 SAND**

- A. ASTM C144, natural sand containing not more than 2 percent of silt and clay by weight with specific gravity not less than 2.65.
- 2.4 LIME:
- A. ASTM C5, slake; screen through 16 mesh, then store and protect for 10 days.
- 2.5 Mortar:
- A. ASTM C270, Type S, cement-lime proportion specification mix. Admixtures and Type N lime are not acceptable.
  - B. Hydrated Lime: ASTM C207 Type S.
  - C. Sand: ASTM C144.
  - D. Portland Cement: ASTM C150/C150M.
  - E. Color: medium to light gray color added to mortar. Submit color samples for acceptance.
- 2.6 GROUT:
- A. Hydrated Lime: ASTM C207, Type S.
  - B. Aggregate For Masonry Grout: ASTM C404, Size 8.
  - C. Blended Hydraulic Cement: ASTM C595, Type IS, IP.
  - D. Portland Cement: ASTM C150, Type I.
  - E. Water: Potable, free of substances that are detrimental to grout, masonry, and metal.
- 2.7 REINFORCING MATERIALS
- A. Reinforcing bars: ASTM A 615/A 615M, Grade 40 or 60 steel, galvanized or epoxy coated when cover is less than 1.5 in
  - B. Anchors, dowels, other anchoring devices, and shims: standard building stone anchors commercially available in a non-corrosive material such as zinc plated, hot dipped galvanized steel, brass, or stainless steel Type 302 or 304.

### **PART 3 - EXECUTION**

#### **3.1 SETTING TOLERANCE**

- A. Set stones: +/- 1/8 inch
- B. Joints: + 1/16 inch, - 1/8 inch

#### **3.2 JOINTING**

##### **A. JOINT SIZE:**

- 1. Horizontal stone/brick joints: 3/8 inch (9.5 cm)
- 2. Vertical stone/stone joints: 1/4 inch (6 mm) or 3/8 inch (9.5 mm)
- 3. Stone/stone joint exposed on top: 3/8 inch (9.5 mm)

##### **B. JOINT MATERIALS:**

- 1. Mortar: Type N, ASTM C 270
- 2. Full bed of mortar at bed joints
- 3. Flush vertical joints full with mortar

- C. Location of joints:
  - 1. At control and expansion joints unless otherwise shown

### 3.3 SETTING STONE

- A. Drench units with clean water prior to setting
- B. Fill dowel holes and anchor slots with mortar or non-shrink grout
- C. Set units in full bed of mortar, unless otherwise detailed
- D. Rake mortar joints 3/4 inch (18 mm) for pointing
- E. Remove excess mortar from unit faces immediately after setting
- F. Tuck point unit joints to a slight concave profile

### 3.4 MOCK-UP

Provide a minimum 8 foot long mockup starting at one wall end including end caps, top caps, and wall veneer over reinforced concrete stem wall and footing per project requirements. Mockup shall include color range, texture, bond pattern, and joints. Do not continue stone masonry work until mock-up has been approved by the COR in writing.

--- End of Section ---

**SECTION 05 05 13  
FACTORY-APPLIED COATING FOR METAL**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Factory-applied metal coatings.
- B. Hot-dip galvanizing and high-performance super durable thermosetting based coating for iron and steel fabrications.

**1.2 RELATED SECTIONS**

- A. Section 051200 - Structural Steel Framing.
- B. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Prime and finish painting: Section 09 91 00, PAINTING

**1.3 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM A123 / A123M - 15 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel ProductsA 153
  - 2. D3359 - 09e2 Standard Test Methods for Measuring Adhesion
  - 3. D3363 - 05(2011)e2 Standard Test Method for Film Hardness by Pencil Test
  - 4. B117 - 16 Standard Practice for Operating Salt Spray (Fog) Apparatus
  - 5. D2247 - 15 Standard Practice for Testing Water Resistance of Coatings
  - 6. ASTM D2794 - 93(2010) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
  - 7. ASTM D2244 - 16 Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
  - 8. ASTM D4214 : Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
  - 9. D523 - 14 Standard Test Method for Specular Gloss
  - 10. ASTM B244 - 09(2014) Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals
- B. American Architectural Manufacturers Association (AAMA):
  - 1. 2604 Powder Coated Finish

**1.2 SUBMITTALS**

- A. Product Literature for Factory-Applied Metal Coatings: Submit galvanizer's product literature for coatings specified in this Section including test data.
- B. Verification Samples for Factory-Applied Metal Coatings: Submit two 3-inch by 6-inch samples of factory-applied coatings and colors proposed for use for approval prior to coating application.
- C. Certificate of Compliance for Items Coated by Galvanizer: If requested, submit notarized Certificate of Compliance with application for payment for galvanizing, signed by the galvanizer,

- indicating compliance with requirements of specifications. Include scope of services provided, and quantity and itemized description of items processed.
- D. Certificate of Compliance for Shop Drawing Review by Galvanizer: If requested, submit galvanizer's certification that shop drawings for metal fabrications to receive metal coatings have been reviewed and that fabrications are acceptable to galvanizer for proper application of galvanizing and metal coatings. Drawings shall be signed by the galvanizer to indicate acceptance of design for galvanizing.
  - E. Certificate of Compliance of Item Identification by Galvanizer: Lots of material shall have visible tag indicating name of the galvanizer, type and weight of the coating, and applicable ASTM standards. If requested, submit certification of compliance that items have been tagged.
  - F. Substitutions: If substitutions or other products are proposed, submit this Specification signed by firm proposing other products, indication line-by-line comparison of proposed substitution or equal product with test results. Substitutions proposed with comparison test results will not be accepted.
  - G. Galvanizer's written Quality Control/Quality Assurance manual for hot dip galvanizing and factory applied coating.
  - H. Certification from the American Galvanizers Association that Galvanizer has completed course requirements and is a certified Master Galvanizer.

### **1.3 QUALITY ASSURANCE**

- A. Galvanizer Qualifications: Engage services of a qualified galvanizer who has demonstrated a minimum of ten years' experience in successful application of galvanized coatings specified in the facility where the Work is to be performed and who will apply the coatings within the same facility.
- B. Coating Applicator's Qualifications: Galvanizing and factory-applied coatings shall be performed by a company with a minimum of ten years' experience in the successful application of hot-dip galvanizing utilizing the dry kettle process.
- C. Pre-Construction Conference for Metal Fabrications to Receive Factory-Applied Metal Coatings: Schedule a meeting to be attended by Contractor, Architect, fabricator, and galvanizer. Agenda shall include the following: Project schedule, scope of services, coordination between fabricator and galvanizer, finish of surfaces, application of coatings, color selections, submittals, and approvals.
- D. Coordination between Fabricator and Galvanizer: Prior to fabrication and final submittal of shop drawings to Architect, direct fabricators to submit shop drawings to the galvanizer for metal fabrications to receive factory-applied metal coatings. Direct galvanizer to review fabricator's shop drawings for suitability of materials for galvanizing and coatings and coordinate any required modifications to fabrications..
- E. Environmental Compliance: Coatings shall be certified OTC/VOC compliant and conform to EPA standards and local regulations.

## **PART 2 - PRODUCTS**

### **2.1 HOT DIP GALVANIZING AND HIGH PERFORMANCE SUPER DURABLE THERMOSETTING BASED COATING**

- A. Hot-Dip Galvanizing: For steel exposed to the elements, weather, or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by

the hot-dip process. Galvanizing bath shall contain special high-grade zinc and other earthy materials.

1. Basis-of-Design: Duragalv by Duncan Galvanizing or others meeting requirements of this specification.
  2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
  3. Provide thickness of galvanizing specified in referenced standards.
  4. Fill vent holes after galvanizing, if applicable, and grind smooth.
  5. Galvanizing shall exhibit a rugosity (smoothness) 4 rug or less (16-20 microns of variation) when measured by a profilometer over a 1-inch straight line on surface of elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.
- B. High-Performance Thermosetting Based Coating: Provide coating matching approved samples. Factory-applied metal coatings shall be applied in a facility acceptable to coating manufacturer. Factory applied coating shall include an architectural grade primer. Full cure of coating system shall be verified by the coating manufacturer's recommended test methods. Coatings must meet or exceed criteria for the following categories as stipulated by the coatings manufacturer. Testing was performed on lab prepared panels.
1. Duncan Colorgalv ThermosetSM by Duncan Galvanizing or others meeting requirements of this specification.
  2. Coating shall meet or exceed the following criteria as established by the coating manufacturer.
    - a. Adhesion: ASTM D 3359, no loss.
    - b. Hardness: ASTM D 3363 (pencil), H min.
    - c. Falling Sand: ASTM D 968 20L/mil.
    - d. Salt Spray: ASTM B 117, passes 3000 hrs.
    - e. Humidity: ASTM D 2247, 3000 hours, few #8 blisters.
    - f. Impact Resistance (3mm): ASTM D 2794, no loss.
    - g. Color Retention: ASTM D 2244, 5 year less than or equal to 5 delta E.
    - h. Chalk Resistance: ASTM D 4214, #8 rating.
    - i. Gloss Retention: ASTM D 523, greater than or equal to 30 percent retention.
    - j. Erosion Resistance: ASTM B 244, less than 10 percent film loss.
    - k. Compliance: AAMA 2604.
  3. Color shall be as selected by architect in a "semi-gloss" finish
  4. Warranty: Provide galvanizer's standard warranty that materials will be free from 10 percent or more visible rust for 20 years.

## **PART 3 - EXECUTION**

### **1.1 APPLICATION OF FACTORY-APPLIED METAL COATINGS**

- A. Galvanizing Application: Galvanize materials in accordance with specified standards and this specification. Galvanizing shall provide an acceptable substrate for applied coatings. The dry

- kettle process shall be used to eliminate any flux inclusions on the surface of the galvanized material.
- B. Prior to galvanizing, the steel shall be immersed in a pre-flux solution (zinc ammonium chloride). Pre-flux tank must be 12 to 14 Baumé density and contain less than 0.4 percent iron. Use of the wet kettle process is not acceptable. To provide the galvanized surface required, the following procedures shall be implemented:
    - 1. A monitoring recorder shall be utilized and inspected regularly to observe any variances in the galvanizing bath temperature.
    - 2. Pickling tanks shall contain hydrochloric acid with an iron content less than 8 percent and zinc content less than 3 percent. Titrations shall be taken weekly at a minimum.
    - 3. Chemicals and zinc shall be tested at least once a week to determine compliance with ASTM standards. Testing shall be done using atomic absorption spectrometry or x-ray fluorescence (XRF) equipment at a lab in the galvanizing plant.
  - C. Finish coatings shall be applied under the following conditions.
  - D. Minimum air temperature shall be 65 degrees F. Surface temperature of steel shall be 60 degrees to 95 degrees F and, in any event, be 5 degrees F higher than the dew point. Humidity shall be 85 percent maximum.
  - E. Use of iron or steel shot and sand and aluminum oxide grit as a blast medium, and power wire brushes are not permitted.
  - F. Surface of substrate shall be dry and free from dust, dirt, oil, grease or other contaminants. Coating and cure facility shall be maintained free of airborne dust and dirt until coatings are completely cured.

### 3.02 INSTALLATION

- A. Installation: Comply with fabricator's and galvanizer's requirements for installation of materials and fabrications, including use of nylon slings or padded cables for handling factory-coated materials.
- B. Touch-Up and Repair: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.
  - 1. For galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A 780, modified to 95 percent zinc in dry film. Galvanizing repair paint shall have 95 percent zinc by weight, ZiRP by Duncan Galvanizing. Thickness of applied galvanizing repair paint shall be not less than coating thickness required by ASTM A 123 or A 153 as applicable. Touch-up of galvanized surfaces with silver paint, brite paint, or aluminum paints is not acceptable.
  - 2. For factory-applied finish coatings, field-touch-up shall be performed by factory-approved personnel for warranties to apply. Touch-up shall be such that repair is not visible from a distance of 6 feet. If non factory-approved technicians are used for field touch-up, no warranties shall exist.
  - 3. A touch-up repair kit or touchup instructions shall be provided to the VA for each type of factory-applied finish.

---End of Section---

**SECTION 05 12 00  
STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges.

**1.2 RELATED SECTIONS**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Painting:
  - 1. Section 09 91 00, PAINTING
  - 2. Section 05 05 13, FACTORY APPLIED COATING FOR METAL

**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 commencement of steel erection, ensure that the steel erector is provided with written notification required by 29 CFR 1926.752. Provide copy of this notification to the COR.

**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).

## 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

Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

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

## 1.7 REFERENCES

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

- A. 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).
- B. American National Standards Institute (ANSI):
  - B18.22.1-65(R2008) ..... Plain Washers

C. 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
- A123/A123M-09 ..... Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- 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

D. American Welding Society (AWS):

- D1.1/D1.1M-10 ..... Structural Welding Code-Steel

E. Research Council on Structural Connections (RCSC) of The Engineering Foundation:

- Specification for Structural Joints Using ASTM A325 or A490 Bolts

F. Military Specifications (Mil. Spec.):

- MIL-P-21035..... Paint, High Zinc Dust Content, Galvanizing, Repair

## **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. Tighten 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 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 INSTALLATION

- 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 installation, 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.

- - - End of Section - - -

**SECTION 06 30 00  
WOOD LOUVERS**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Rain screened wood siding system for exterior and interior application with concealed fasteners.

1.2 RELATED SECTIONS

- A. Color of wood siding: Section 09 06 00, SCHEDULE FOR FINISHES.

1.3 SUBMITTALS

Submit in accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

- A. Manufacturer's Literature and Product Data:
  - 1. Wood.
  - 2. Accessories.
- B. Shop Drawings:
  - 1. Show details of louver system at 1:50 (1/4 inch) scale, fastener, details of construction, methods of anchorage, and details of installation.
- C. Samples:
  - 1. Two 300 mm (one-foot) samples of wood louver material.
  - 2. Fasteners.
- D. Maintenance Instructions: Provide manufacturers maintenance and cleaning instructions.
- E. LEED Submittals, Certified Wood: Submit chain-of-custody certificates signed by manufacturer certifying that wood siding products comply with LEED forest certification and chain-of-custody requirements. Include evidence that mill is certified for chain-of custody by an FSC-accredited certification body. Include statement indicating costs for each certified wood siding product. See Section, 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS: LEED submittal and LEED credit documentation.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Minimum five years' experience producing similar products.
- B. Certified: wood species certified as FSC Pure according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship".
- C. Finishes: Work specified to have transparent finish in this Section shall be identical in color, appearance, and finish with that specified in Section 09 06 00, SCHEDULE OF FINISHES. Submit required samples to the COR for review.
- D. Field Measurements: Take field measurements prior to preparation of shop

drawings and fabrication; do not delay job progress; allow for trimming and fitting where necessary.

#### 1.5 WARRANTY

- A. Provide manufacturer's standard 25-year warranty for hardwood siding materials against insect damage and decay.

### **PART 2 PRODUCTS**

#### 2.1 MATERIALS

- A. Wood Louver:
  - 1. Size: 1-inch x 6-inch nominal, Ipe wood (Brazilian Walnut) straight grain lumber
    - a. Average dried weight: 69 pounds/cubic foot (1,100 kg/m<sup>3</sup>).
- B. Louver Components: 1/4-inch threaded stainless steel rod, type 304.
- C. Fasteners: Stainless fasteners as detailed.

### **PART 3 - EXECUTION**

#### 3.1 PREPARATION

- A. Prior to start fabrication and of installation, inspect existing conditions to ensure surfaces are suitable for installation of louver system and that adequate structural support has been provided.

#### 3.2 INSTALLATION

- A. Install in accordance with approved shop drawings.
- B. Install materials be plumb, true to line, cut, and fitted.

#### 3.3 CLEANING AND PROTECTING

- A. Protect from damage during construction operations. Promptly repair any damaged surfaces. Remove and replace work that cannot be satisfactorily repaired.
- B. Clean using materials recommended by manufacturer to remove stains, dirt, and debris prior to final acceptance.

- - - End of Section - - -

**SECTION 09 06 00  
SCHEDULE FOR FINISHES**

**PART 1 – GENERAL**

**1.1 SECTION INCLUDES**

- A. Schedule for requirements specified in other sections identified by abbreviated material names and finish codes by location.

**1.2 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.

**1.3 REFERENCES**

- 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)  
2001 ..... Architectural Painting Specification Manual

**PART 2- PRODUCTS**

**2.1 Division 32 - Site Improvements**

- A. SECTION 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS
  - 1. For Cement and Concrete for Exterior Improvements, Section 32 05 23 refer to specification section.
- B. SECTION 32 13 20, SITE CONCRETE
  - 1. For Site Concrete, Section 32 13 20 refer to specification section.

**2.2 DIVISION 33 – SANITARY SEWER UTILITIES**

- A. SECTION 33 30 00, SANITARY SEWER UTILITIES

1. For Sanitary Sewer Utilities, Section 33 30 00 refer to specification section.

**2.3 DIVISION 34 - SITE IMPROVEMENTS**

A. SECTION 34 40 00, STORM DRAIN UTILITIES

1. For Storm Drain Utilities, Section 34 40 00 refer to specification section.

**2.4 DIVISION 05 – METALS**

A. SECTION 05 12 00, STRUCTURAL STEEL FRAMING

Component	Finish	Color
Pavilion - Frames	Shop powder coated over HDG, Gloss Level 5 Semi-Gloss	Kelly Moore-Sierra White

B. SECTION 05 50 00, METAL FABRICATION

Item	Finish
Pavilion-Wire Mesh Frames, Panel Channel Units	Stainless Steel Type 304
Pavilion Panels - Wire Mesh	Stainless Steel Type 304

**2.5 DIVISION 06 WOOD, PLASTICS, AND COMPOSITES**

A. SECTION 06 30 00, WOOD LOUVERS

WOOD LOUVERS	
Location	Finish
Upper Plaza Pavilions	Ipe –prefinished penetrating oil all sides

**2.6 DIVISION 09 – FINISHES**

A. SECTION 09 91 00, PAINT AND COATINGS

1.	MPI Gloss and Sheen Standards		Gloss @60	Sheen @85
	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	

**2.7 DIVISION 10 – SPECIALTIES**

A. SECTION 10 22 13.01 / 10 13 00 / 10 14 00

1. Refer to specific specification sections.

B. SECTION 10 22 13.01, WIRE MESH PANELS

Location	Finish
Upper Plaza-Pavilions	S.S. Type 304

**2.8 DIVISION 12- FURNISHINGS**

A. SECTION 12 93 00, SITE FURNISHINGS

1. For site furnishings refer to specification Section 12 93 00

**2.9 DIVISION 26 - ELECTRICAL**

A. SECTION 26 56 00, SITE LIGHTING

Type and Component	Exterior Finish	Manufacturer	Mfg. Name/No.
C, In-grade	Manufacturer's Polyester powder coat "Stealth Gray"	Kim	
D, Step Lights	Manufacturer's powder coated Aluminum "Silver"	Bega	Bega/2197
F, Pole Light and Pole	Manufacturers standard finish – Silver (SLV)	Bega	Pole Top Indirect Cutoff Optics-8309MH- Pole-916HR

**PART 3 EXECUTION**

(Not Used.)

---End of Section---

**SECTION 09 91 00  
PAINTING**

**PART 1-GENERAL**

**1.1 SECTION INCLUDES**

- A. Field painting.
- B. Prime coats which may be applied in shop under other sections.
- C. Shellacs, stains, varnishes, and coatings specified.

**1.2 RELATED SECTIONS**

- A. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 SUBMITTALS**

- A. Manufacturer's Literature and Data:
  - 1. Before work is started, or sample panels are prepared, submit manufacturer's literature, current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of date of contract award, and other information to be able to sufficiently determine compliance with these specifications. Each coating system is to be from a single manufacturer. Coats on a particular substrate shall be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- B. 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: metal, wood, glass or as appropriate to final product and finish, 100 mm by 250 mm by 3 mm thick (4 inches by 10 inches by 1/8 inch thick).
  - 3. Panel to show transparent finishes: Wood of same species and grain pattern as wood approved for use, 100 mm by 250 mm by 3 mm thick (4 inches by 10 inches 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 mm by 50 mm (2 inches by 2 inches) 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 inches) wide strips of undercoats and 100 mm (4 inches) wide strip of finish coat.
- C. Sample of identity markers if used.
- D. Manufacturers' Certificates indicating compliance with specifications:
1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
  2. High temperature aluminum paint.
  3. Epoxy coating.

#### 1.4 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).

#### 1.5 REFERENCES

- A. 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)
- B. American National Standards Institute (ANSI):  
A13.1-07 ..... Scheme for the Identification of Piping Systems
- C. American Society for Testing and Materials (ASTM):  
D260-86.....Boiled Linseed Oil
- D. Commercial Item Description (CID):

- A-A-1555 ..... Water Paint, Powder (Cementitious, White and Colors)  
(WPC) (cancelled)
- E. Federal Specifications (Fed Spec):
  - TT-P-1411A ..... Paint, Copolymer-Resin, Cementitious (For Waterproofing  
Concrete and Masonry Walls) (CEP)
- F. Master Painters Institute (MPI):
  - No. 1-12 ..... Aluminum Paint (AP)
  - No. 4-12 ..... Interior/ Exterior Latex Block Filler
  - No. 5-12 ..... Exterior Alkyd Wood Primer
  - No. 7-12 ..... Exterior Oil Wood Primer
  - No. 8-12 ..... Exterior Alkyd, Flat MPI Gloss Level 1 (EO)
  - No. 9-12 ..... Exterior Alkyd Enamel MPI Gloss Level 6 (EO)
  - No. 10-12 ..... Exterior Latex, Flat (AE)
  - No. 11-12 ..... Exterior Latex, Semi-Gloss (AE)
  - No. 18-12 ..... Organic Zinc Rich Primer
  - No. 22-12 ..... Aluminum Paint, High Heat (up to 590% - 1100F) (HR)
  - No. 26-12 ..... Cementitious Galvanized Metal Primer
  - No. 31-12 ..... Polyurethane, Moisture Cured, Clear Gloss (PV)
  - No. 36-12 ..... Knot Sealer
  - No. 71-12 ..... Polyurethane, Moisture Cured, Clear, Flat (PV)
  - No. 77-12 ..... Epoxy Cold Cured, Gloss (EC)
  - No. 79-12 ..... Marine Alkyd Metal Primer
  - No. 91-12 ..... Wood Filler Paste
  - No. 94-12 ..... Exterior Alkyd, Semi-Gloss (EO)
  - No. 95-12 ..... Fast Drying Metal Primer
  - No. 98-12 ..... High Build Epoxy Coating
  - No. 101-12 ..... Epoxy Anti-Corrosive Metal Primer
  - No. 108-12 ..... High Build Epoxy Coating, Low Gloss (EC)
  - No. 119-12 ..... Exterior Latex, High Gloss (acrylic) (AE)
  - No. 135-12 ..... Non-Cementitious Galvanized Primer
- G. Steel Structures Painting Council (SSPC):
  - SSPC SP 1-04 (R2004) Solvent Cleaning
  - SSPC SP 2-04 (R2004) Hand Tool Cleaning
  - SSPC SP 3-04 (R2004) Power Tool Cleaning

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Aluminum Paint (AP): MPI 1.
- B. Exterior Oil Wood Primer: MPI 7.
- C. Exterior Alkyd, Flat (EO): MPI 8.
- D. Exterior Alkyd Enamel (EO): MPI 9.
- E. Exterior Latex, Flat (AE): MPI 10.
- F. Exterior Latex, Semi-Gloss (AE): MPI 11.
- G. Organic Zinc rich Coating (HR): MPI 22.
- H. High Heat Resistant Coating (HR): MPI 22.
- I. Cementitious Galvanized Metal Primer: MPI 26.
- J. Epoxy Cold Cured, Gloss (EC): MPI 77.
- K. Marine Alkyd Metal primer: MPI 79.
- L. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- M. Fast Drying Metal Primer: MPI 95.
- N. High Build Epoxy Coating: MPI 98.
- O. Epoxy Anti-Corrosive Metal Primer: MPI 101.
- P. High Build Epoxy Marine Coating (EC): MPI 108.
- Q. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
- R. Waterborne Galvanized Primer: MPI 134.
- S. Non-Cementitious Galvanized Primer: MPI 135.

### **2.2 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 referenced Specifications for primers, use primers with pigment and vehicle compatible with substrate and finish coats specified.

### **2.3 REGULATORY REQUIREMENTS/QUALITY ASSURANCE**

- A. Paint materials shall conform to 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 250 grams/liter and shall not be formulated with more than one percent aromatic hydro carbons by weight.

## **PART 3 – EXECUTION**

### **3.1 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 site at end of each day's 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 product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
  2. Do no exterior painting when it is windy and dusty.
  3. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
  4. 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.
5. 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.

### 3.2 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. Wood:
  1. Sand to a smooth even surface and then dust off.
  2. Sand surfaces showing raised grain smooth between each coat.
  3. Wipe surface with a tack rag prior to applying finish.
  4. Surface painted with an opaque finish:
    - a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.
    - b. Apply two coats of MPI 36 (Knot Sealer) over large knots.
  5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand surface to make smooth and finish flush with adjacent surface.
  6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.

D. 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). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors 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.

E. 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.

### 3.3 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 paint manufacturer.

### 3.3 APPLICATION

- A. Start of surface preparation or painting will be construed as acceptance of 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 Resident Engineer.
- E. Finish surfaces to show solid even color, free from runs, lumps, brush marks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
- G. Do not paint in closed position operable items such as access doors and panels, doors, and similar items.

### 3.4 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. Metals except boilers, incinerator stacks, and engine exhaust pipes:
  - 1. Zinc-coated steel and iron: MPI 134 (Waterborne Galvanized Primer)  
Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).

### 3.5 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).

### 3.6 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. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
- G. Sand or dull glossy surfaces prior to painting.
- H. Sand existing coatings to a feather-edge so that transition between new and existing finish will not show in finished work.

### 3.7 PAINT COLOR

- A. Color and gloss of finish coats is specified in Drawings.
- B. 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 finish coat and to mask surface imperfections or contrasts.

### 3.8 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE

- A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body, and finish coats to materials and equipment if not factory finished in space scheduled to be finished.
- B. In spaces not scheduled to be finish painted, paint as specified under paragraph H, colors.
- C. Paint after tests have been completed.
- D. Omit prime coat from factory prime-coated items.
- E. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.
- F. Color:
  - 1. Paint items having no color specified in to match surrounding surfaces.
  - 2. Paint colors as specified in drawings except for following:
    - a. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conduits containing fire alarm control wiring, and fire alarm equipment.
    - b. Federal Safety Orange: Entire lengths of electrical conduits containing feeders 600 volts or more.
- G. Apply paint systems on properly prepared and primed surface as follows:
  - 1. Apply two coats of MPI 94 (Exterior Alkyd, Semi-gloss (EO)) to fire hydrants, post indicators, yard hydrants, exposed piping and similar items.

2. Apply two coats of MPI 11 (Exterior Latex, Semi-Gloss (AE)) to galvanized and zinc-copper alloy metal.

### 3.9 BUILDING AND STRUCTURAL WORK NOT TO BE PAINTED

#### A. Prefinished items/Finished surfaces:

1. Hardware except ferrous metal.
2. Anodized aluminum, stainless steel, chromium plating, as otherwise specified.
3. Signs, fixtures, and other similar items integrally finished.

#### B. Labels:

1. Code required label, such as Underwriters Laboratories Inc., Inchcape Testing Services, Inc., or Factory Mutual Research Corporation.
2. Identification plates, instruction plates, performance rating, and nomenclature.

#### C. Galvanized metal:

1. Exterior chain link fence and gates, and gratings.
2. Except where specifically specified to be painted.

#### D. Metal safety treads and nosings.

#### E. Gaskets.

#### F. Concrete curbs, gutters, pavements, retaining walls, exterior exposed foundations walls and interior walls in pipe basements.

#### G. Face brick.

#### H. Structural steel encased in concrete, masonry, or other enclosure.

#### I. Structural steel to receive sprayed-on fire proofing.

### 3.10 IDENTITY PAINTING SCHEDULE

- A. Electrical Conduits containing feeders over 600 volts, paint legends using 50 mm (2 inch) high black numbers and letters, showing voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 6100 mm (20 foot) intervals in between. Use labels with yellow background with black border and words Danger High Voltage Class, 5000, 15000, or 25000 as appropriate.

#### B. See Sections for methods of identification, legends, and abbreviations of the following:

1. Conduits containing high voltage feeders over 600 volts: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS / Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS / Section 28 05 33, RACEWAYS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY.

### 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.

- - - End of Section - - -

**SECTION 10 22 13.01  
WIRE MESH PANELS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

Stainless steel mesh panels complete with hardware.

**1.2 RELATED SECTIONS**

- A. Structural Steel Framing: Section 06 30 00
- B. Schedule of Finishes: Section 09 06 00

**1.3 REFERENCES**

- A. American Society for Testing and Materials (ASTM):  
A36/36M-08 ..... Carbon Structural Steel

**1.4 SUBMITTALS**

Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

- A. Shop Drawings: Mesh panels, showing design, construction and materials.
- B. Provide layout drawings with detailed erection drawings and specifications.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Woven wire mesh : Halo™ 1162, Designer Series, Stainless Steel Type 304, 62 percent open area, long way of opening parallel to N/A, sheet, 48 inches wide x 96 inches long by McNICHOLS quality or equal.
- B. Steel shapes, plates and bars: ASTM A36/36M.
  - 1. Vertical Channel: 10-gage, 2-inch leg U-channel frame, Stainless Steel Type 304
  - 2. Horizontal Channel: 10-gage, 2-inch leg U-channel frame, Stainless Steel Type 304
  - 3. Tabs: 3- 1/2 inches x 4 inches x 5/16 inch, Stainless Steel plates, Type 304

**2.2 FABRICATION**

- A. Weld wire mesh to frame grind smooth and polish as necessary for a uniform finish.
- B. Weld tabs to frame, grind smooth and polish as necessary for a uniform finish.
- C. Frame corners to be mitered and free of sharp edges, grind smooth and polish as necessary for a uniform finish.
- D. Finish: Stainless Steel type 304

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Erect panels in accordance with architectural drawings and detailed shop drawings.
- B. Secure panels to each other and Pavilion frame using mechanical fasteners.

**3.2 ACCEPTANCE**

- A. Repair or replace damaged parts, touch-up abraded paint with matching paint.
- B. Panels shall be level and firm. Adjust hardware to operate smoothly and securely.

---End of Section---

**SECTION 12 93 00  
SITE FURNISHINGS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Benches, trash/recycling receptacles, and drain covers.

**1.2 SUBMITTALS**

Per Section **01 33 23**, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

- A. Surface-Mounted Benches
  - 1. Manufacturer cut-sheets including materials, dimensions, model
  - 2. Color / finish samples
- B. Trash / Recycling Receptacles
  - 1. Manufacturer cut-sheets including materials, dimensions, model
  - 2. Color / finish samples
- C. Drain Covers
  - 1. Manufacturer cut-sheets including materials, dimensions, model

**1.03 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM A48 / A48M - 03(2016) Standard Specification for Gray Iron Castings

**PART 2 – MATERIALS**

**2.1 SURFACE-MOUNTED BENCHES**

- A. “Knight” Bench by Forms+Surfaces or approved equal
  - 1. With back-rest
  - 2. With arm-rests
  - 3. Surface mount per manufacturer’s specifications
  - 4. Bench to be furnished by contractor and installed by contractor
  - 5. Ipe wood slats
  - 6. “Aluminum Texture” powder-coat finish on hardware
  - 7. 6 feet Long or as noted in plans

**2.2 TRASH RECEPTACLES**

- A. “Dispatch” Receptacle by Forms+Surfaces
  - 1. Solid Cast Aluminum with powder-coat finish
  - 2. Body: “Aluminum Texture”
  - 3. Lid: “Slate Texture”
  - 4. No graphics, no recycling openings
  - 5. Lift lever latch
  - 6. Liner without holes
  - 7. Surface mount without concrete base, per manufacturer’s specifications

**2.3 DRAIN COVERS IN PAVED AREAS**

- A. “OPCB” by Urban Accessories or Approved Equal
  - 1. Size as noted in drawings
  - 2. High quality 100 percent recycled grey iron; ASTM A48 Class 35B or better; hardness 170-223 Brinell

3. Finish: Galvanized

### **PART 3 - EXECUTION**

#### **3.1 GENERAL INSTALLATION**

- A. Perform work in accordance with applicable laws, codes and regulations required by the City of Palo Alto and the State of California.
- B. Install manufactured items in accordance with manufacturer's instruction and as shown on Drawings.
- C. Set Work true and square, plumb and level. Remove and replace any wood that splits during or after erection until acceptance.
- D. Place washer under head and nut of bolts where same bear on wood, except head of carriage bolt. Drill bolt holes same diameter as bolt.
- E. Size bolts to fit flush with nuts. Countersink nuts and bolts as detailed.
- F. Supply miscellaneous metal units and install as specified herein under the Sections titled Miscellaneous Metal work.
- G. Hot-dip galvanize metal fastenings, angles, etc., after complete fabrication.
- H. Galvanized metal that is cut damaged or modified after fabrication shall be immediately painted with Zinc-rich paint to prevent rusting.
- I. Touch up paint any damaged surfaces to match original finish as accepted by the COR.
- J. Set site furniture, level. Provide spacers under furniture to level as acceptable to COR.
- K. Transport, store and handle precast units and manufactured items in a manner to avoid hairline cracks, staining or other damage. Store units free of the ground and protected from mud or rain splashes. Cover units, secure covers firmly, and protect the units from dust, dirt, or other staining material.

---End of Section---

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

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Provisions that apply to Sections of Division 26.

**1.2 RELATED SECTIONS**

- A. Section 00 73 19 HEALTH AND SAFETY REQUIREMENTS
- B. Section 01 78 23 OPERATION AND MAINTENANCE DATA

**1.3 DEFINITIONS**

A. Listed:

1. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
2. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

B. Labeled:

1. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
2. Laboratory makes periodic inspections of the production of such equipment.
3. Labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

C. Certified:

1. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
2. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
3. Bears a label, tag, or other record of certification.  
Nationally recognized testing laboratory approved.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Wiring ampacities specified or shown on Drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are prohibited.
- B. Equipment location shall be as close as practical to locations shown on Drawings.

C. Inaccessible Equipment

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Government.

**PART 2 PRODUCTS**

2.1 PRODUCT QUALIFICATIONS INCLUDE

- A. Manufacturer regularly and presently produces Work item.
- B. Work item shall be one of manufacturer's principal products
- C. Manufacturer has manufactured item for at least three years.
- D. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

**PART 3 EXECUTION**

3.1 SAFETY

- A. Electrical work must comply with NFPA 70 (NEC), NFPA 70B, NFPA 70E, and OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K.
- B. Work on energized circuits or equipment shall not occur until prior written approval is obtained from the VA.

3.2 EQUIPMENT PROTECTION

- A. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
- B. Damaged equipment shall be, as determined by the COR, placed in first class operating condition or be returned to the source of supply for repair or replacement.
- C. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
- D. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by manufacturer so repaired areas are not obvious.

3.3 PRE-OUTAGE COORDINATION MEETING

- A. Apply for utility outages at least 15 days in advance (major outages, i.e. outages which will affect other builders or will be greater than four hours in duration, shall be requested at least 30 days in advance).
- B. As a minimum, request should include location of outage, utilities being affected, duration of outage, and any necessary sketches.

- C. Once approved, and prior to beginning work on utility system requiring shut down, attend a pre-outage coordination meeting with the COR and the Public Utilities representative to review scope of work and lock-out/tag-out procedures for worker protection.

#### 3.4 TRAINING

- A. Training shall be provided for particular equipment or system as required in each associated specification.
- B. Training schedule shall be developed and submitted by the Contractor and approved by the COR at least 30 days prior to planned training.

--- End of Section ---

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

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Electrical conductors and cables for use in electrical systems rated 600 V and below.

1.2 RELATED SECTIONS

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- 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.

1.3 QUALITY ASSURANCE

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

1.4 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.

1.5 SUBMITTALS

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

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

## 1.6 REFERENCES

- A. American Society of Testing Material (ASTM):  
D2304-10 ..... Test Method for Thermal Endurance of Rigid Electrical  
Insulating Materials
- B. National Fire Protection Association (NFPA):  
70-11 ..... National Electrical Code (NEC)

## 1.7 DEFINITIONS

- A. Cable(s), conductor(s), wire, or wiring are used interchangeably in this section.

## **PART 2 - PRODUCTS**

### 2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on Drawings.
- B. 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 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 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 color coding indicated above. 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.

## 2.2 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. Integral insulator shall have a skirt to completely cover stripped conductors.
  - 3. Number, size, and combination of conductors used with the connector, as listed on 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 particular use, location, voltage, and temperature. Insulation level shall be not less than insulation level of the conductors being joined.
  3. Splice and insulation shall be product of the same manufacturer.
  4. 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 particular use, location, voltage, and temperature. Insulation level shall be not less than 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. Integral insulator shall have a skirt to completely cover stripped conductors.
  3. Number, size, and combination of conductors used with connector, as listed on 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 particular use, location, voltage, and temperature. Insulation level shall be not less than 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.

### 2.3 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. Bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

### 2.4 CONTROL WIRING

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

### 2.5 WIRE LUBRICATING COMPOUND

- A. Lubricating compound shall be suitable for 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**

### 3.1 GENERAL

- A. Install conductors in accordance with the NEC, as specified, and as shown on Drawings.
- B. Install 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 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 conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from last fixed point of connection to 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 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 conductors.
  - 4. 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 conductor or remove conductor strands.

### 3.2 INSTALLATION IN MANHOLES

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

### 3.3 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 splices or terminations at no additional cost to the Government.

### 3.4 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 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.

### 3.5 FEEDER CONDUCTOR IDENTIFICATION

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

### 3.6 EXISTING CONDUCTORS

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

### 3.7 CONTROL WIRING INSTALLATION

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

### 3.8 CONTROL WIRING IDENTIFICATION

- A. Install a permanent wire marker on each wire at each termination.

- B. Identifying numbers and letters on wire markers shall correspond to those on 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 system served and function.

### 3.9 DIRECT BURIAL CABLE INSTALLATION

- A. Tops of the cables:
  - 1. Below 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 trenches before installing cables.
  - 2. Place 75 mm (3 inches) shading sand over 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 cables before backfilling.
- E. Provide horizontal slack for contraction during cold weather.
- F. Install cables in continuous lengths. Splices within cable runs shall not be accepted.
- G. Connections and terminations shall be listed submersible-type designed for cables being installed.
- H. Warning tape shall be continuously placed 300 mm (12 inches) above buried cables.

### 3.10 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with 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 three-phase circuits.

--- End of Section ---

**SECTION 26 05 26  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. General grounding and bonding requirements of electrical equipment operations and low impedance path for possible ground fault currents.

1.2 RELATED SECTIONS

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. Sufficient information, clearly presented as to be able to determine compliance with drawings and specifications.
  - 2. Include location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
- B. Test Reports: Provide certified test reports of ground resistance.
- C. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
  - 1. Certification that materials and installation is in accordance with Drawings and Specifications.
  - 2. Certification that the installation has been properly tested.

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - B1-2001 ..... Standard Specification for Hard-Drawn Copper Wire
  - B8-2004 ..... Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

- C. National Fire Protection Association (NFPA):
  - 70-2005 ..... National Electrical Code (NEC)
  - 99-2005 ..... Health Care Facilities
- D. Underwriters Laboratories, Inc. (UL):
  - 83-2003 ..... Thermoplastic-Insulated Wires and Cables
  - 467-2004 ..... Grounding and Bonding Equipment

#### 1.4 DEFINITIONS

- A. “Grounding electrode system” refers to electrodes required by NEC, as well as including made, supplementary, lightning protection system grounding electrodes.
- B. The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.

### **PART 2 - PRODUCTS**

#### 2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.
- D. Electrical System Grounding: Conductor sizes shall not be less than what is shown on t Drawings and not less than required by the NEC, whichever is greater.

## 2.2 GROUND RODS

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

## 2.3 SPLICES AND TERMINATION COMPONENTS

Components shall meet or exceed UL 467 and be clearly marked with manufacturer, catalog number, and permitted conductor size(s).

## 2.4 GROUND CONNECTIONS

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
  - 1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
  - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
  - 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

## 2.5 EQUIPMENT RACK AND CABINET GROUND BARS

Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

## 2.6 GROUND TERMINAL BLOCKS

At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

## 2.7 SPLICE CASE GROUND ACCESSORIES

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding:
  - 1. Secondary service neutrals: Ground at supply side of secondary disconnecting means and at related transformers.
  - 2. Separately derived systems (transformers downstream from service entrance): Ground secondary neutral.
  - 3. Isolation transformers and isolated power systems shall not be system grounded.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), 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. Special Grounding: For patient care area electrical power system grounding, conform to NFPA 99, and NEC.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

### **3.3 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 or high voltage conductors, sized per NEC except that minimum size shall be 25 mm<sup>2</sup> (2 AWG). Bond equipment grounding conductors to the switchgear ground bus, to manhole hardware and ground rods, to cable shielding grounding provisions of medium or high voltage cable splices and terminations, and equipment enclosures.
- C. Pad Mounted Transformers:
  - 1. Provide a driven ground rod and bond with a grounding electrode conductor to transformer grounding pad metal steel.

2. Ground secondary neutral.
- D. Lightning Arresters: Connect lightning arresters to equipment ground bus or ground rods as applicable.
  - E. Outdoor Metallic Fences Around Electrical Equipment: Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a 25 mm<sup>2</sup> (4 AWG) copper conductor, by exothermic weld to ground rods and extend underground to immediate vicinity of fence post. Lace conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Each gate section shall be bonded to its gatepost by a 3 by 25 mm (1/8 by one inch) flexible braided copper strap and ground post clamps. Clamps shall be of anti-electrolysis type.
  - F. Metallic Conduit: 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 bare grounding conductor to equipment ground bus.

### 3.4 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond secondary service neutral to ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
  1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. Connections to electrodes shall be made with fittings that conform to UL 467.
  2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
  1. Connect the various feeder equipment grounding conductors to ground bus in the enclosure with suitable pressure connectors.

2. For service entrance equipment, connect grounding electrode conductor to the ground bus.
  3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- E. Transformers:
1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at transformer secondary. Provide a grounding electrode at the transformer.
  2. Separately derived systems (transformers downstream from service equipment): Ground secondary neutral at the transformer. Provide a grounding electrode conductor from transformer to the ground bar at the service equipment.
- F. Conduit Systems:
1. Ground metallic conduit systems. Metallic conduit systems shall contain an equipment grounding conductor.
  2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
  3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at entrance and exit from the conduit.
- G. Feeders and Branch Circuits: Install equipment grounding conductors with feeders and power and lighting branch circuits.
- H. 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.

3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate equipment grounding conductors.
  - I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
  - J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
  - K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when green ground is provided; otherwise, ground fixtures through the conduit systems. 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.
  - L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
  - M. Raised Floors: Provide bonding of raised floor components.
  - N. Panelboard Bonding: Equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 16 mm<sup>2</sup> (10 AWG). These conductors shall be installed in rigid metal conduit.

### 3.5 CORROSION INHIBITORS

When making ground and ground bonding connections, apply a corrosion inhibitor to contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between metals used.

### 3.6 CONDUCTIVE PIPING

- A. Bond conductive piping systems, interior and exterior, to the building 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 gases and suction piping, at the outlets, directly to the room or patient ground bus.

### 3.7 LIGHTNING PROTECTION SYSTEM

Bond lightning protection system to electrical grounding electrode system.

### 3.8 ELECTRICAL ROOM GROUNDING

Building Earth Ground Busbars: Provide ground busbar hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

### 3.9 WIREWAY GROUNDING

A. Ground and Bond Metallic Wireway Systems as follows:

1. Bond metallic structures of wireway to provide 100 percent electrical continuity throughout wireway system by connecting a 16 mm<sup>2</sup> (6 AWG) bonding jumper at intermediate metallic enclosures and across section junctions.
2. Install insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers between wireway system bonded as required in paragraph 1 above, and closest building ground at each end and approximately every 16 meters (50 feet).
3. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at intermediate metallic enclosures and cross section junctions.
4. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

### 3.10 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.
- B. Resistance of 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 electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. Combined

resistance of separate systems may be used to meet required resistance, but the specified number of electrodes must still be provided.

- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before connections are ready for inspection.

### 3.11 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve specified resistance.

--- End of Section ---

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

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Grounded raceways.

1.2 RELATED SECTIONS

- A. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- D. 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.

1.3 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 main feeders;
  - 2. Size and location of panels and pull boxes
  - 3. Layout of required conduit penetrations through structural elements.
  - 4. Specific item proposed and its area of application shall be identified on catalog cuts.
- B. Certification: Prior to final inspection, deliver to the COR certification that material is in accordance with Drawings and Specifications and has been properly installed.

1.4 REFERENCES

- A. Underwriters Laboratories, Inc. (UL):
  - UL 1-03..... Flexible Metal Conduit
  - UL 5-01..... Surface Metal Raceway and Fittings
  - UL 6-03..... Rigid Metal Conduit
  - UL 360-03..... Liquid-Tight Flexible Steel Conduit
  - UL 467-01..... Grounding and Bonding Equipment
  - UL 514B-02 ..... Fittings for Cable and Conduit
  - UL 514C-05..... Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
  - UL 651-02..... Schedule 40 and 80 Rigid PVC Conduit
  - UL 651A-03 ..... Type EB and A Rigid PVC Conduit and HDPE Conduit

- UL 797-03..... Electrical Metallic Tubing
- UL 1242-00..... Intermediate Metal Conduit
- B. National Electrical Manufacturers Association (NEMA):
  - FB1-03..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit,  
Electrical Metallic Tubing and Cable

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 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 aluminum: Shall Conform to UL 6A, ANSI C80.5.
  - 3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
  - 4. 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.
  - 5. Flexible galvanized steel conduit: Shall Conform to UL 1.
  - 6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
  - 7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high-density polyethylene (PE).
  - 8. Surface metal raceway: Shall Conform to UL 5.
- C. Conduit Fittings:
  - 1. Rigid steel and IMC conduit fittings:
    - a. 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 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 setscrews 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.
2. Rigid aluminum conduit fittings:
- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
- b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
- c. Set screw fittings: Not permitted for use with aluminum conduit.
3. Electrical metallic tubing fittings:
- a. 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. UL 514B. Only steel or malleable iron materials are acceptable.
- b. Clamp type, with insulated throat.
5. Liquid-tight flexible metal conduit fittings:
- a. 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. UL 514C and NEMA TC3.
- b. As recommended by conduit manufacturer.
7. Surface metal raceway fittings: As recommended by 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.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- 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 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**

#### **3.1 PENETRATIONS**

- A. Cutting or Holes:

1. Locate holes in advance where they are proposed in structural sections such as ribs or beams. Obtain approval of the COR prior to drilling through structural sections.
  2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the COR as required by limited working space.
- 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 spread of fire, smoke and gases with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around conduit and make watertight.

### 3.2 INSTALLATION, GENERAL

In accordance with UL, NEC, and as shown:

- 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 damaged conduits with new undamaged material.
  3. Assure conduit installation does not encroach into ceiling height headroom, 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 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 inside of 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 Drawings or specified herein, 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 proposed deviations have been submitted approved by the COR.

### 3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
  - a. Where shown on structural drawings.
  - b. As approved by the COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
  - a. Conduit outside diameter larger than 1/3 of slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
  - c. Install conduits approximately in center of slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through conduits. Tightening set screws with pliers is prohibited.

B. 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 (6 feet) of flexible metal conduit extending from a junction box to the fixture.
  5. Tightening set screws with pliers is prohibited.

### 3.4 EXPOSED WORK INSTALLATION

- A. Unless otherwise indicated on 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 (8-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 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 cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

### 3.5 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 kind of material, direct burial type, and UL approval label.
  3. Install conduit fittings and terminations as recommended by 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. Excavation for conduit bedding and back-filling of trenches is specified in Section 31 20 00, EARTH MOVING.
    - a. Cut trenches neatly and uniformly.
    - b. Do not kink conduits.
  7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents entrance of moisture and gases.
  8. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with 0.5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
  9. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.
- B. Exterior routing of lighting systems and other branch circuits (600 volts and less-under buildings slab on grade to 1500 mm (5 feet) from the building):
1. Pre-coated rigid galvanized steel conduit in accordance with requirements of Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

### 3.6 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.

### 3.7 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 0.5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

### 3.8 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.

### 3.9 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 couplings in accordance with 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 sum of weights of 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. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
    - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited except: Horizontal and vertical supports/fasteners within walls.
- L. 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 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 wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On branch circuit junction box covers, identify circuits with black marker.

--- End of Section ---

## **SECTION 26 05 41 UNDERGROUND ELECTRICAL CONSTRUCTION**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Precast manholes and pullboxes with ducts to form a complete underground raceway system.

#### **1.2 RELATED SECTIONS**

- A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- 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.

#### **1.3 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.

#### **1.4 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 Drawings shall be clearly marked on submittals. If it is necessary to locate manholes or pullboxes at locations other than shown on Drawings, show proposed locations accurately on scaled site drawings, and submit four copies to the COR for approval prior to construction.
- C. Certifications: Two weeks prior to final inspection, submit the following certifications to the COR:
  1. Certification that materials have been properly installed, connected, and tested.

## 1.5 REFERENCES

- A. Institute of Electrical and Electronic Engineers (IEEE):  
C2-07 ..... National Electrical Safety Code
- B. Underwriters Laboratories, Inc. (UL):  
UL 6-07 ..... Electrical Rigid Metal Conduit-Steel  
UL 651-05 ..... Schedule 40 and 80 Rigid PVC Conduit and Fittings
- C. American Society for Testing and Materials (ASTM):  
ASTM C858 - 10e1 ..... Standard Specification for Underground Precast  
Concrete Utility Structures  
ASTM D1557 - 12e1 ..... Standard Test Methods for Laboratory Compaction  
Characteristics of Soil Using Modified Effort

## PART 2 - PRODUCTS

### 2.1 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 inches (56 mm) x 0.25 inch (6 mm) in size, and punched with 14 holes on 1.5 inch (38 mm) centers for attaching cable arms.

2. Cable arms shall be 0.1875 inch (5 mm) gage, hot-rolled, hot-dipped galvanized sheet steel, pressed to channel shape. Arms shall be approximately 2.5 inches (63 mm) wide x 14 inches (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-inch (75 mm) PVC sleeve in manhole floors so that a driven ground rod may be installed.

## 2.2 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 requirements of ANSI/SCTE 77 loading. Provide pulling irons, 0.875 inch (22 mm) diameter galvanized steel bar with exposed triangular-shaped opening.
- B. Concrete Pullboxes: Shall be monolithically-poured reinforced concrete.

## 2.3 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 degrees F [90 degrees 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 degrees F (75 degrees C) rated conductors.
2. Rigid metal conduit: UL6 and NEMA RN1 galvanized rigid steel, threaded type, half-lapped with 10 mil PVC tape.

## 2.4 GROUNDING

- A. Rods: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. Ground Wire: Stranded bare copper 6 AWG (16 mm<sup>2</sup>) minimum.

## 2.5 WARNING TAPE

Standard 4-mil polyethylene 3-inch (76 mm) wide detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

## 2.6 PULL ROPE FOR SPARE DUCTS

Plastic with 200 pounds (890 N) minimum tensile strength.

# PART 3 - EXECUTION

## 3.1 MANHOLE AND PULLBOX INSTALLATION

- A. Assembly and installation shall follow printed instructions and recommendations of manufacturer. Install manholes and pullboxes level and plumb.
  1. Units shall be installed on a 12-inch (300 mm)]level bed of 90 percent relative compaction (ASTM D1557) granular fill, well-graded from the 1 inch (25 mm) sieve to 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 top of frames and covers are flush with finished grade.
- C. Ground Rods in Manholes: Drive a ground rod into the earth, through floor sleeve, after manhole is set in place. Fill sleeve with sealant to make a watertight seal. Rods shall protrude approximately 4 inches (100 mm) above manhole floor.
- D. Grounding in Manholes:

1. Install a No. 3/0 AWG (95 mm<sup>2</sup>) bare copper ring grounding conductor around inside perimeter of the manhole and anchor to the walls with metallic cable clips.
2. Connect ring grounding conductor to ground rod by an exothermic welding process.
3. Bond ring grounding conductor to duct bank equipment grounding conductors, exposed non-current carrying metal parts of racks, sump covers, and like items in manholes with a minimum No. 6 AWG (16 mm<sup>2</sup>) bare copper jumper.

### 3.2 TRENCHING

- A. Cut trenches neatly and uniformly.
- B. For Concrete-Encased Ducts:
  1. After excavation of trench, stakes shall be driven in the bottom of the trench at 4 feet (1.2 M) intervals to establish grade and route duct bank.
  2. Pitch trenches uniformly toward manholes or both ways from high points between manholes for required duct line drainage. Avoid pitching ducts toward buildings wherever possible.
  3. Walls of trench may be used to form sidewalls of the duct bank, provided that 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 concrete-encased duct has sufficiently cured, trench shall be backfilled to grade with earth, and appropriate warning tape installed.
- C. 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.

### 3.3 DUCT INSTALLATION

- A. General Requirements:
  1. Ducts shall be in accordance with 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 inches (100 mm) in 100 feet (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 feet (1.5 M) outside the building foundation. Tops of conduits below building slab shall be minimum 24 inches (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 feet (1.5 M) away from edge of slab.
5. Install insulated grounding bushings on 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. Multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of duct assembly a minimum of 3 inches (75 mm) above bottom of the trench during concrete pour. Spacer spacing shall not exceed 5 feet (1.5 M). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of ducts during pouring of concrete. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 12 inches (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 inches (75 mm).
  - b. For power and signal services, not less than 6 inches (150 mm).
11. Duct lines shall terminate at window openings in manhole walls as shown on Drawings. Ducts shall be fitted with end bells.
12. Couple ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of 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. Direct-Burial Duct and Conduit Identification: Place continuous strip of warning tape approximately 12 inches (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 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. Mandrel shall be not less than 12 inches (3600 mm) long, and shall have a diameter not less than 0.5 inch (13 mm) less than inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove loosened particles. Diameter of brush shall be the same as, or slightly larger than, the diameter of duct.
  2. Mandrel pulls shall be witnessed by the COR.
- E. Duct and Conduit Sealing: Seal ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent 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 flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches (300 mm) in each direction. Perimeter of duct bank opening in underground structure shall be flared toward inside or keyed to provide a positive interlock between duct and wall of the manhole. Use vibrators when this portion of 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 dimensions required and preserve the steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with duct bank envelope.
- H. Connections to Existing Ducts: Where connections to existing duct banks are indicated, excavate around duct banks as necessary. Cut off ducts and remove loose concrete from inside before installing new ducts. Provide a reinforced-concrete collar, poured monolithically with 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 feet (0.6 M) back into the envelope and a minimum of 2 feet (0.6 M) beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches (75 mm) from the edge of envelope. Secure corner bars with two No. 3 ties, spaced approximately 12 inches (300 mm) apart. Restrain reinforcing assembly from moving during pouring of concrete.

- - - END OF SECTION - - -

## **SECTION 26 09 23 LIGHTING CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 RELATED SECTIONS**

- 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
- 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.

#### **1.2 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

#### **1.3 SUBMITTALS**

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

- A. 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.

#### **1.4 REFERENCES**

- A. Underwriters Laboratories, Inc.:

- UL 773..... Standard for Plug-In Locking Type Photocontrols for Use  
with Area Lighting
- UL 773A..... Nonindustrial Photoelectric Switches for Lighting Control
- UL 917.....Clock Operated Switches

## **PART 2 - PRODUCTS**

### **2.1 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 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.

### **2.2 ELECTROMECHANICAL-DIAL TIME SWITCHES**

- A. Electromechanical-dial time switches; 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.

### **2.3 OUTDOOR PHOTOELECTRIC SWITCHES**

- A. Solid state, with SPST dry contacts rated for 1800 VA tungsten or 1000 VA inductive, 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.

## 2.4 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 ballasts.
  2. Warning: Audible warning to sound during 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.

## 2.5 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 square inches (232 square cm).

- C. Detection Coverage: as scheduled on drawings.
- D. Individually Mounted Sensor: Contacts rated to operate connected relay, 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.

## 2.6 LIGHTING CONTROL PANEL – RELAY TYPE

- A. Controller: 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.

## 2.7 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**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on 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 manufacturer's recommendations. Adjust sensor for scheduled light level at the typical work plane for that area.
- F. Label time switches and contactors with a unique designation.

### 3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with 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.

### 3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, show to the COR 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**

**1.1 SECTION INCLUDES**

Exterior luminaries, controls, poles and supports.

**1.2 RELATED SECTIONS**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- C. Section 26 05 13, MEDIUM-VOLTAGE CABLES.
- D. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- F. 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.

**1.3 SUBMITTALS**

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

- A. Shop Drawings:
  - 1. Sufficient information, clearly presented, sufficient 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, luminaries, lamps and controls.
- B. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the COR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement parts.
- C. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
  - 1. Certification that materials are in accordance with Drawings and Specifications.
  - 2. Certification that installation has been and tested.

**1.4 REFERENCES**

- A. Aluminum Association Inc. (AA):

- AAH35.1-2006 .....Alloy and Temper Designation Systems for Aluminum
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - LTS-4-2003 ..... Structural Supports for Highway Signs, Luminaries and Traffic Signals
- C. American Concrete Institute (ACI):
  - 318-2005 .....Building Code Requirements for Structural Concrete
- D. American National Standards Institute (ANSI):
  - C81.61-2005 ..... Electrical Lamp Bases
- E. American Society for Testing and Materials (ASTM):
- F. Federal Aviation Administration (FAA):
  - AC 70/7460-IK CHG 1-2000 ..... Obstruction Lighting and Marking
  - AC 150/5345-43E-1995 Specification for Obstruction Lighting Equipment
- G. Illuminating Engineering Society of North America (IESNA)
  - HB-9-2000 .....Lighting Handbook
  - RP-8-2000 (R-2005)..... Roadway Lighting
- H. National Electrical Manufacturers Association (NEMA):
  - C78.41-2001 ..... Electric Lamps – Guidelines for Low-Pressure Sodium Lamps
  - C78.42-2004 ..... Electric Lamps – Guidelines for High-Pressure Sodium Lamps
  - C78.43-2005 ..... Electric Lamps – Single-Ended Metal-Halide Lamps
  - C78.1381-1998 ..... (R 1997) Electric Lamps – 70-Watt M85 Metal-Halide Lamps
  - C82.4-2002 .....Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
  - C136.17-2005 ..... Roadway Lighting Equipment – Enclosed Side-Mounted Luminaries for Horizontal-Burning High-Intensity-Discharge Lamps
  - ICS 2-2005 ..... Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts
  - ICS 6-2001 ..... Industrial Control and Systems Enclosures
- I. National Fire Protection Association (NFPA):
  - NEC 70-2005 ..... National Electrical Code (NEC)
- J. Underwriters Laboratories, Inc. (UL):
  - 496-2004 ..... Edison-Base Lamp holders
  - 773-1995 ..... Plug-in, Locking Type Photo controls, for Use with Area Lighting
  - 773A-2006 ..... Non-industrial Photoelectric Switches for Lighting Control
  - 1029-1994 ..... High-Intensity-Discharge Lamp Ballasts
  - 1598-2004 ..... Luminaries

### **1.5 DELIVERY, STORAGE, AND HANDLING**

Steel Poles: Do not store poles on ground. Store poles so they are at least 305 mm (one foot) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS AND EQUIPMENT**

Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on Drawings and specified.

### **2.2 POLES**

#### **A. General:**

1. Poles shall be straight round cast aluminum alloy as shown on Drawings, and as specified. Finish shall be as specified on Drawings.
2. Pole assembly shall be designed for wind loading of 161 km/hr (100 miles per hour), with an additional 30 percent gust factor, supporting luminaire(s) having effective projected areas indicated. Effective projected area of pole shall be applied at the height of the pole base as shown on Drawings.
3. Poles shall be anchor-bolt type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 65 by 125 mm (2.5 by 5 inches). Handhole cover shall be secured by stainless steel captive screws.
4. Provide a steel-grounding stud opposite hand hole openings.
5. Provide a base cover matching pole in material and color to conceal mounting hardware pole-base welds and anchor bolts.
6. Hardware: Shall be 300 series stainless steel.

#### **B. Types:**

1. Aluminum: Provide Aluminum poles manufactured of corrosion-resistant AA AAH35.1 aluminum alloys conforming to AASHTO LTS-4. Poles shall be seamless extruded or spun seamless type.

### **2.3 FOUNDATIONS FOR POLES**

- A. Foundations shall be cast-in-place concrete.
- B. Foundations shall support effective projected area of specified pole, arm(s), and luminaire(s) under wind conditions previously specified in this section.
- C. Place concrete in spirally wrapped treated paper forms for round foundations, and construct forms for square foundations.

- D. Rub-finish and round above-grade concrete edges to approximately 6 mm (1/4 inch) radius.
- E. Concrete shall have 3000 psi minimum 28 day compressive strength.
- F. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on Drawings and meet ACI 318. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
- G. Prior to concrete pour, install a copperclad steel ground rod, not less than 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, below each foundation. Drive the rod vertically under foundation so not less than 1800 mm (6 feet) of rod is in contact with the earth. Remainder of rod may be in the concrete pour. Where rock or layered rock is present, drill a hole not less than 50 mm (2 inches) in diameter and 1800 mm (6 feet) deep, backfill with tamped fine sand and drive the rod into the hole. Bond the rod to the pole with not less than number 6 AWG bare copper wires. Method of bonding shall be approved for the purpose.

## **2.4 LUMINAIRES**

- A. 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. IESNA HB-9 and RP-8 light distribution pattern types shall be as shown on Drawings.
- C. Incorporate ballasts in the luminaire housing except where otherwise shown on Drawings.
- D. Lenses shall be frame-mounted heat-resistant, borosilicate glass, prismatic refractors. 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 luminary doors.
- E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking type porcelain enclosures in conformance to applicable requirements of ANSI C81.61 and UL 496.
- F. Pre-wire internal components to terminal strips at the factory.
- G. Bracket mounted luminaires shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.
- H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- I. IESNA Cutoff Category: cutoff.

## **2.5 LAMPS**

- A. Install proper lamps in every luminaire installed.
- B. Lamps to be general-service, outdoor lighting types.

- C. High-Pressure Sodium (HPS) Lamps: NEMA C78.42, wattage as indicated. Lamps shall have average rated life of 16,000 hours minimum for 35-watt lamps and 24,000 hours minimum for higher wattages.
- D. Low-Pressure Sodium (LPS) Lamps: NEMA C78.41.
- E. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381
- E. LED sources shall meet the following requirements:
  - 1. Operating temperature rating shall be between -40 degrees F and 120 degrees F.
  - 2. Correlated Color Temperature (CCT): 3500K or as shown on drawings.
  - 3. Color Rendering Index (CRI):  $\geq 65$ .
  - 4. Manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Power Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).
- G. Mercury vapor lamps shall not be used.

## 2.6 HIGH INTENSITY DISCHARGE BALLASTS

- A. For low voltage systems, ballasts shall be high efficiency, high power factor, copper-wound constant wattage type and shall meet requirements of UL 1029 and NEMA C82.4.
  - 1. Ballasts shall operate discharge lamp of type, wattage, and voltage shown on Drawings.
  - 2. Ballasts shall have individual overcurrent protection (inline fuse holder) as recommended by ballast manufacturer.
  - 3. Ballasts shall be capable of providing reliable starting of lamps at minus 30 degrees C.
  - 4. Open-circuit operation shall not reduce average life.
- B. For series systems, ballasts shall be high power factor, copper wound constant current type.
  - 1. Provide ballasts to operate discharge lamp of type, wattage, and voltage shown on Drawings.
- C. Locate protective devices for ballasts to be accessible if devices are not integral with ballasts.
- D. Each ballast shall operate not more than one lamp except where otherwise shown on Drawings.

## 2.7 METAL HALIDE ELECTRONIC BALLASTS

- A. Ballast shall be low-frequency electronic type, and shall operate pulse start and ceramic metal halide lamps at a frequency of 90 to 200 Hz square wave.
- B. Ballast shall be labeled Type '1' outdoor, suitable for recessed use, Class 'P'.
- C. Ballast shall have auto-resetting thermal protector to shut off ballast when operating temperatures reach unacceptable levels.
- D. Ballast shall have an end of lamp life detection and shut-down circuit.
- E. Lamp current crest factor shall be 1.5 or less.
- F. Ballasts shall comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
- G. Ballast shall have a minimum ballast factor of 1.0.
- H. Input current THD shall not exceed 20 percent for the primary lamp.
- I. Ballasts shall have ANSI C62.41, category 'A' transient protection.
- J. Ballasts shall have power factor greater than 90 percent.
- K. Ballast shall have a Class 'A' sound rating.

## 2.8 LED DRIVERS

- A. LED drivers shall meet the following requirements:
  - 1. Drivers shall have a minimum efficiency of 85 percent.
  - 2. Starting Temperature: -40 degrees F [-40 degrees C].
  - 3. Input Voltage: 120 to 480 ( $\pm 10$  percent) V.
  - 4. Power Supplies: Class I or II output.
  - 5. Surge Protection: System must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50  $\mu$ s, 10kA/8 x 20  $\mu$ s) waveforms at 1-minute intervals with less than 10 percent 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):  $\geq 0.90$ .
  - 7. Total Harmonic Distortion (THD):  $\leq 20$  percent.
  - 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
  - 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

## 2.9 LIGHTING CONTACTORS

NEMA ICS 2, electrically held contactors. Rate contactors as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactors shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor] and shall require no arcing contacts.

## 2.10 CONTROLS

- A. Each Lighting System:

1. Shall be controlled by one of the following methods as shown for each system on Drawings:
  - a. A photocell to act as the pilot device. Photocell shall be the type which fails safe to the closed position meeting UL 773 or 773A.
  - b. A time clock to act as the pilot device.
  - c. A combination, photocell-time clock to act as dual pilot devices connected in series. Photocell shall provide the "on" function at dusk and the time clock(s) shall control specific circuit "off" functions during dark hours.
  - d. A time clock to act as the pilot device for a circuit (or circuits) when luminaries are individually photocell controlled.
  - e. Pilot devices shall control the power circuit through the conductor or relay as shown on Drawings.
2. Mount and connect photocells and time clocks as shown on Drawings.
3. Photocells shall have the following features:
  - a. Quick-response, cadmium-sulfide type.
  - b. A 15 to 30 second, built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements.
  - c. Energizes the system when the north sky light decreases to approximately 1.5 footcandles, and maintains the system energized until the north sky light increases to approximately 3 to 5 foot-candles.
4. Time clocks shall have the following features:
  - a. A 24-hour astronomic dial, motor-driven.
  - b. A spring-actuated, reserve power mechanism for operating the timer during electrical power failures and that automatically winds the spring when electrical power is restored.
5. Arrangement and method of control and the control devices shall be as shown on Drawings.

#### **2.11 EXISTING LIGHTING SYSTEMS**

- A. For modifications or additions to existing lighting systems, new components shall be compatible with the existing systems.
- B. New poles and luminaries shall have approximately the same configurations and dimensions as the existing poles and luminaries except where otherwise shown on Drawings.

## **2.12 AUXILIARY EQUIPMENT**

- A. Parallel-Type Systems: Shall be supplied power as shown on Drawings.

## **2.13 OBSTRUCTION LIGHTING**

- A. Control devices shall be weatherproof, quick-response, cadmium sulfide type, photoelectric cell relays which will energize the lights at approximately 35 foot-candles as daylight decreases and will de-energize the lights at approximately 85 foot-candles as daylight increases. Mount and position control devices in suitable outdoor locations so they will be actuated by the north skylight.
- B. Circuit raceways or wiring methods exposed to weather, including fittings, shall be weatherproof and include gaskets where required.
  - 1. Minimum conductor size number 12 AWG, copper.
  - 2. Wiring method as shown on Drawings.
- C. For Buildings:
  - 1. Lighting fixtures shall comply with FAA, AC 70/7460-1K and AC 150/5345-43E, and be Type L1-810 duplex units with red Fresnel lenses and 100 watt, type A-21, clear, traffic-signal lamps.
  - 2. Mount lighting fixtures on galvanized, rigid, steel pipe masts attached to roof of the buildings so lighting fixtures extend 305 mm (one foot) above the level of the highest item on the building, including items attached to the roof.
  - 3. Locate lighting equipment in accordance with applicable FAA Standards.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install lighting in accordance with the NEC, as shown on Drawings, and in accordance with manufacturer's recommendations.
- B. Steel Poles:
  - 1. Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
  - 2. After poles have been installed, shimmed and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (3/8-inch) inside

diameter, through the grout tight to the top of the concrete base for moisture weeping.

- C. Foundation Excavation: Depth shall be as indicated. Dig holes large enough to permit proper use of tampers to the full depth of the hole. Place backfill in the hole in 150 mm (6 inch) maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.
- D. Photocell Switch Aiming: Aim switch according to manufacturer's recommendations.

### **3.2 GROUNDING**

Ground noncurrent-carrying parts of equipment including metal poles, luminaries, 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.

--- E N D---

**SECTION 31 20 00  
EARTH MOVING**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Site preparation.
- B. Excavation.
- C. Underpinning.
- D. Filling and backfilling.
- E. Grading.
- F. Soil Disposal.
- G. Earthwork Clean Up.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
  - 1. D448-03a Standard Classification for Sizes of Aggregate for Road and Bridge Construction
  - 2. D1556-00 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
  - 3. D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2700 kN m/m<sup>3</sup>))
  - 4. D2167-94 (2001) Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
  - 5. D2487-06 Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)
  - 6. D2922-05 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  - 7. D2940-03 Standard Specifications for Graded Aggregate Material for Bases or Subbases for Highways or Airports
- B. Society of Automotive Engineers (SAE):
  - 1. J732-92 Specification Definitions - Loaders
  - 2. J1179-02 Hydraulic Excavator and Backhoe Digging Forces

1.3 DEFINITIONS

- A. Unsuitable Materials:
  - 1. Select 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 12 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction (less than 3 percent for native expansive soil), as defined by ASTM D 1557.
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, lime-treatment, or similar methods.
  3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to the COR's approval.
- B. Site 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. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure ASTM D1557. 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 D2922.
  - D. Fill: Suitable soil materials used to raise existing grades; shall be conformable to requirements.
  - E. Backfill: Soil materials or controlled low strength material suitable for use to fill an excavation.
  - F. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization of the COR.
  - G. Authorized additional excavation: Removal of additional material as authorized by the COR to remove unsuitable bearing materials 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.
  - H. Subgrade: Undisturbed earth or compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
  - I. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
  - J. Borrow: Suitable soil imported from off-site for use as fill or backfill.
  - K. Drainage course: Layer that supports slab-on-grade, allows readily for drainage, and minimizes capillary flow of pore water.
  - L. Bedding course: Layer placed over excavated sub-grade in a trench before laying pipe.
  - M. Sub-base Course: Layer placed between sub-grade and base course for asphalt paving or layer placed between sub-grade and a concrete pavement or walk.
  - N. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
  - O. Debris: Materials located within designated work area not covered in other definitions including but not be limited to items like vehicles, equipment, appliances, building

materials or remains thereof, tires, and any solid or liquid chemicals or products stored or found in containers or spilled on the ground.

1.4 SUBMITTALS

A. Soil samples.

1. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
2. Laboratory compaction curve in accordance with ASTM D 1557 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
3. Test reports for compliance with ASTM D 2940 requirements for subbase material.
4. 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.
5. Submit a scale plan daily that defines location, limits, and depths of area excavated and to be excavated.

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Suitable 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 (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter, and approved from on-site or off-site sources having a minimum dry density of 1760 kg/m<sup>3</sup> (110 pcf), a maximum Plasticity Index of 12, and a maximum Liquid Limit of 40.
- 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 a State licensed Professional 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- $\mu$ m (No. 200) sieve, per ASTM D2940. Also, the Liquid Limit shall be less than 40, the Plasticity Index shall be less than 12, and shall not contain rocks greater than three inches in maximum dimension.
- 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- $\mu$ 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. Under concrete slab, crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4), per ASTM D 2940.
2. 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 D 2940.

### **PART 3 - EXECUTION**

#### **3.1 SITE PREPARATION**

- A. Clearing: Remove trees, shrubs, fences, foundations, 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 the COR. Remove materials from Medical Center.
- 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 the COR. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m<sup>3</sup> (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 be carried out when soil is wet.

#### **3.2 EXCAVATION**

- A. Proofrolling
  1. After rough grade has been established in cut areas and prior to placement of fill, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
  2. Proofrolling shall consist of at least two complete passes with second pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or that fail to consolidate after successive. Maintain subgrade until succeeding operation has been accomplished.
- B. 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:
    - 1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).

- 2) Walks: Plus or minus 25 mm (1 inch).
- 3) Pavements: Plus or minus 13 mm (1 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.

### 3.3 FILLING AND BACKFILLING

- A. General: Do not fill or backfill until 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. 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 the COR.

### 3.4 COMPACTION

- B. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
- C. Pavement Subgrade: One test for each 335 m<sup>2</sup> (400 square yards), but in no case fewer than two tests.
- D. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
- E. 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.
- F. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to The COR. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- G. Structural Soil Final Compaction: One test for each 100 m<sup>2</sup> (120 square yards), but in no case fewer than two tests.
- H. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- I. Testing Materials: Test suitability of on-site and off-site borrow as directed by the COR.
- J. Placement: 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 length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost. Placement shall be carried out in the presence of the COR.

#### 1. Fills, Embankments, and Backfill

- a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material: 95 percent relative compaction.
  - b. Under curbs, curbs and gutters: 95 percent relative compaction.
  - c. Under Sidewalks, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material: 95 percent relative compaction.
  - d. Landscaped areas, top 400 mm (16 inches): between 88 and 92 percent relative compaction.
  - e. Landscaped areas, below 400 mm (16 inches) of finished grade: between 88 and 92 percent relative compaction.
2. Natural Ground (Cut or Existing)
- a. Under building slabs, steps and paved areas, top 6 inches: 95 percent relative compaction.
  - b. Under curbs, curbs and gutters, top 6 inches: 95 percent relative compaction.
  - c. Under sidewalks, top 6 inches: 95 percent relative compaction.

### 3.5 GRADING

- A. General: Uniformly grade areas within the limits of this Section, including adjacent transition areas. Smooth 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) at minimum 2 percent slope.
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.

### 3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Place excess excavated materials suitable for fill and/or backfill on site where directed by the COR.
- B. Remove from site and dispose of any excess excavated materials after fill and backfill operations have been completed as determined by the COR.
- C. Segregate excavated contaminated soil designated by the COR from other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. Dispose of excavated contaminated material in accordance with State and Local requirements.

--- End Of Section ---

## **SECTION 31 23 19 DEWATERING**

### **PART 1 - GENERAL**

#### 1.1 SECTION INCLUDES

- A. Dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench.
- B. Permitting Requirements: Obtain and comply with required State and County permits for Work performed.

#### 1.3 RELATED SECTIONS

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING.

#### 1.4 SUBMITTALS

- A. Drawings and Design Data:
  - 1. Submit drawings and data showing method to be employed in dewatering excavated areas 30 days before commencement of excavation:
    - a. Describe in detail dewatering methods to be employed to convey water from site to adequate disposal.
    - b. Include backups and procedures to be adopted to ensure dewatering if problems arise.
    - c. Include location, depth, and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps, and standby units.

### **PART 2 - PRODUCTS**

(Not Used.)

### **PART 3 - EXECUTION**

#### 3.1 OPERATION

- A. Provide dewatering to allow material to be excavated to grades shown in reasonably dry conditions, to allow construction operations in the dry, and to protect damage to structures.

- B. Operate dewatering system continuously until backfill work has been completed.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.
- F. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

### 3.2 WATER DISPOSAL

- A. Dispose of water removed from the excavations in such a manner as will:
  - 1. Not endanger portions of work under construction or completed.
  - 2. Cause no inconvenience to Government or to others working near site.
  - 3. Comply with stipulations of required permits for disposal of water.
  - 4. Control runoff in work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas.

### 3.3 DAMAGES

- A. Immediately repair damages to adjacent facilities caused by dewatering operations.

--- End of Section ---

**SECTION 31 23 23.33  
FLOWABLE FILL**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Flowable fill for use as structural fill.

1.2 PERFORMANCE REQUIREMENTS

- A. Flowable fill materials will be used as structural fill replacement. Materials and mix design for the flowable fill should produce a mix comparable compressive strength to the surrounding soil after hardening, making excavation at a later time possible using hand tools.

1.3 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Design strength for this permanent type flowable fill shall be a compressive strength of 2.1 MPa (300 psi) minimum at 28 days.

1.5 SUBMITTALS

- A. 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 final product meets strength and flow consistency, and shrinkage requirements included in this Specification.

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 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.
  - c. Flowable fill shall have a unit weight of 1900 – 2300 kg/m<sup>3</sup> (115 – 145 lb/cubic-foot) measured at the point of placement after a 60 minute ready-mix truck ride.
- B. Provide documentation that admixture supplier has experience of at least one year, with products being provided and any equipment required to obtain desired performance of the product.

- C. Manufacturer's Certificates: Provide COR with a certification that materials incorporated in the flowable fill, following achievement of required strength, do not represent a threat to groundwater quality.

## 1.6 REFERENCES

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

- A. American Society for Testing and Materials (ASTM):
  - 1. C150-99 Rev.A-04 Standard Specification for Portland Cement
  - 2. C33-03 Standard Specification for Concrete Aggregates
  - 3. C494/C494M-04 Standard Specification for Chemical Admixtures for Concrete
  - 4. C940 - 16 Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
- B. American Concrete Institute (ACI)
  - 1. 229R-99 (2005) Controlled Low-Strength Materials

## 1.7 QUALITY ASSURANCE

- A. Manufacturer: Flowable fill shall be manufactured by a ready-mix concrete producer with a minimum of 1 year experience in 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: 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 COR aware of the conditions for which he recommends use of flowable fill, and the COR 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. Prior to commencement of field operations the Contractor shall establish procedures to maintain optimum working conditions and coordinate this Work with related and adjacent Work.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and handle products and equipment required, in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.

## 1.9 PROJECT CONDITIONS

- A. Perform installation of flowable fill only when approved by the COR, and when existing and forecasted weather conditions are within the limits established by manufacturer of materials and products used.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Portland Cement: ASTM C150, Type 2. Meeting Caltrans Standard Specifications.
- B. Mixing Water: Meeting Caltrans Standard Specifications for use as mix-water for cast-in-place concrete.
- C. Air-Entraining Admixture: ASTM C260.
- D. Chemical Admixtures: ASTM C494.
- E. Aggregate: ASTM C33.

### **2.2 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 2.1 MPa (300 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/m<sup>3</sup> (115 – 145 pounds/cubic-feet) measured at the point of placement after a 60 minute ready-mix truck ride.
- E. Flowable fill shall have an in-place yield of a maximum of 110 percent of design yield for removable types at 1 year.
- F. Provide equipment as recommended by 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**

### **3.1 EXAMINATION**

- A. Examine conditions of substrates and other conditions under which work is to be performed and notify the COR, in writing, of circumstances detrimental to the proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

### **3.2 INSTALLATION**

- A. Provide flowable fill in a fluid condition, that sets within the required time and, after curing, obtains the desired strength properties as evidenced by laboratory testing of the specific mix design, at locations shown on the Plans or as directed by the COR in writing. Flowable fill shall remain excavatable using hand tools.

### 3.3 PROTECTION

- A. Secure tanks, pipes and other members to be encased in flowable fill. Ensure no exposed metallic pipes, conduits, or other items 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 placement of flowable fill.

### 3.4 CURING

- A. Protect exposed surfaces of flowable fill from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature.
- B. Curing method shall be subject to approval by the COR.

---End of Section---

**SECTION 32 11 36  
CONCRETE BASE COURSES**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

- A. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- B. 03 30 00 CAST-IN-PLACE CONCRETE

1.2 REFERENCES

Latest version at time of award shall apply:

- 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)
  - T099-09-UL Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 pounds) Rammer and a 305 mm (12-inch) Drop
  - T180-09-UL Moisture-Density Relations of Soils Using a 4.54 kg (10 pounds) Rammer and a 457 mm (18-inch) Drop
- B. California Department of Transportation (CALTRANS) Standard Specifications:
  - Section 68-1.025 Permeable Aggregate Materials and Filter Fabrics

**PART 2 PRODUCTS**

2.1 AGGREGATE BASE

- A. Conform to requirements of Section 26-1.02B of the Caltrans Standard Specifications, Class 2 Aggregate Base, 3/4 inch maximum grading.

**PART 3 EXECUTION**

3.1 DAMPPROOFING

- A. Dampproof behind Planter Walls: CALTRANS Standard Specifications, Section 54.

3.2 SUBSURFACE DRAINAGE

- A. Concrete 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. Provide black colored rodent-proof cap over exposed outfalls as accepted by the COR.

- - - End of Section - - -

**SECTION 32 14 12  
CONCRETE PAVERS**

**PART 1 - GENERAL**

1.1 QUALITY ASSURANCE

- A. Person who is thoroughly familiar with type of materials being installed and methods for installation shall oversee and ensure quality of concrete paver work.

1.2 SUBMITTALS

- A. Concrete Unit Pavers. Submit:
1. Product cut-sheet and product literature.
  2. Full size paver samples of each type of paver used indicating full range of color and finish to be expected in completed work.
- B. Construct an 8-foot by 8-foot minimum sample area at job site with 2 by 4's restraints and vibrate in place including color patterns, bands, and paver field with edges cut to match restraints. Protect sample panel until paving work is accepted. Locate panel where directed by the COR.

1.3 PRODUCT HANDLING

- A. Deliver and unload concrete and stone pavers at job site on pallets and bound in such a manner that no damage occurs to the product during hauling, handling, and unloading at the job site. Provide bedding and joint sand in such a manner as to deter contamination including saturation of water.

1.4 REFERENCES

- A. American Society For Testing And Materials (ASTM):
- |                          |   |
|--------------------------|---|
| ASTM C150 / C150M - 16e1 | Standard Specification for Portland Cement                              |
| ASTM C33/C33M-16e1       | Standard Specification for Concrete Aggregates                          |
| ASTM D1557 - 12e1        | Standard Test Methods for Laboratory Compaction Characteristics of Soil |
- B. CALTRANS Department of Transportation Specifications
- |          |                         |
|----------|-------------------------|
| 90-3.03  | Fine Aggregate Gradings |
| 26.1.02A | Aggregate Base Courses  |

**PART 2 - PRODUCTS**

2.1 CONCRETE PAVERS

- A. Concrete and stone pavers shall be produced by single source manufacturers. Concrete pavers shall be sealed as recommended by manufacturer.
1. Concrete Unit Paver: 3 by 18 by 4 inches, "Granada White" #1401 (with Slag), "Light Sandblast", by Stepstone Inc. Gardena, CA (800) 572-9029; or approved equal.
  2. Concrete Unit Pavers over slot drain assembly: 3 by 18 by 2-1/2 inches, "Granada White" #1401 (with Slag), "Light Sandblast", by Stepstone Inc. Gardena, CA (800) 572-9029; or approved equal.
  3. Concrete Pavers: Concrete pavers shall be made from 5000 psi (34,450 kPa) hardrock concrete using Type III cement.
  4. Materials used to manufacture concrete pavers shall conform to the following:
    - a. Cement: ASTM C150 (Portland Cement)

- b. Aggregates: ASTM C33 (washed, graded sand and rock; no expanded shale or lightweight aggregates).

2.2 SAND LAYING COURSE

- A. Sand laying course shall conform to ASTM C33 as follows:

<u>Sieve Size</u>	<u>3/8 inch</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>
percent passing	100	95-100	80-100	1-12	25-60	10-30	2-10

- B. Fine aggregate gradings shall conform to 90-3.03:
  - 1. Thickness of sand laying course nominal 1 inch and uniform to ensure an even surface.

2.3 SAND JOINT FILLER

- A. Plaster sand.

2.4 SEALER

- A. Joint stabilizing Sealer, Teflon based or epoxy-modified, penetrating sealer and joint sand stabilizer. VOC, EPA, OSHA and FDA compliant through 2007 and as recommended by concrete paver manufacturer.

2.5 AGGREGATE BASE (Base Rock)

- A. Aggregate base shall be crushed aggregate, R-78 minimum, 3/4 inch maximum, conforming to Caltrans Standard Specifications 26.1.02A, Class 2, free from vegetable matter or other deleterious substances.

2.6 MORTAR BED

- A. Latex-Portland Cement Mortar

**PART 3 - EXECUTION**

3.1 SUBGRADE PREPARATION

- A. Provide subgrade preparation and 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 90 percent relative compaction as determined by ASTM D1557 laboratory test procedure and in Sections 19, 25 and 26 of the Caltrans Standard Specifications.
- B. After clearing subgrade of vegetation and debris in accordance with Section 16 of the Caltrans Standard Specifications, remove boulders, hardened material, and rock encountered. Earth shall be uniform for the full depth and width of the subgrade.

3.2 AGGREGATE BASE

- A. Deliver to site as a uniform mixture and spread each layer in one operation without segregation.
- B. Spread and compact Class 2 Aggregate Base to a minimum of 95 percent 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. Elevation of compacted surface shall not deviate more than  $\pm 1/2$  inch over a 10-foot straightedge.

3.3 SAND LAYING COURSE

- A. Install dry sand to uniform depth required for flush finish after pavers are installed. Designed nominal depth shall be one inch thick with no sand thickness less than 3/4 inch

or more than 1-1/2 inch. Sand is to remain undisturbed prior to installation of pavers.  
Moisture content of sand to remain constant.

3.4 CONCRETE SUB-SLAB

- A. Install as shown on Drawings and accepted by the COR.

3.5 PAVER INSTALLATION

- A. Before installation, clean pavers of foreign material. Do not begin installation of pavers until subgrade and base have been prepared per Specifications.
- B. Screed sand bedding course to recommended depth. Sand is to remain undisturbed prior to installation of unit pavers. Maintain constant sand moisture content.
- C. Start installation from a corner or straight edge, unless detailed otherwise, and proceed forward over undisturbed sand-bedding course with pavers as shown on Drawings.
- D. Install pavers plumb and true to line and grade to coincide and align with adjacent work and elevations in accordance with Drawings. Use string lines to hold pattern lines true. Maximum vertical deflection shall not exceed 3/8 inch under a 10-foot straightedge. Perimeter edges must be retained to secure pavers and sand-bedding course. Provide retainer as required. No paver joint shall be greater than 1/4 inch. No perimeter edge joint shall be greater than 3/8 inch.
- E. Cut pavers with a double bladed stone cutter or diamond blade masonry saw.
- F. Use a plate vibrator to compact pavers and to vibrate sand up into the joints between pavers. A plate type vibrating compactor capable of 3,000 to 5,000 pounds centrifugal compaction force should be used to compact unit pavers into sand-bedding course. Two to three 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 the COR.
- G. 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 the COR.
- H. Spread plaster sand over installed and approved pavers and vibrate into the joints between pavers. Make several passes with plate compactor while sweeping sand into the paver joints. Ensure joints are full before clean up. Excess sand should be swept up and removed from completed unit paver installation. Completed paving installation shall be swept and washed down to provide a clean, finished, hardscape pavement.
- I. Protect paved areas from damage and stains during installation and throughout remainder of the Project until final project acceptance. Sweep and wash down completed installation to provide a clean, finished, workmanlike hardscape pavement.
- J. Final surface elevation of pavers shall not deviate more than 3/8 inch under a 10 foot long straightedge and shall not deviate more than 1/8 inch between individual pavers.
- K. Surface elevation of pavers shall be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.
- L. Apply sealer after final cleanup and wash down of paving surfaces.
- M. Prior to applying sealer, remove any stains and efflorescence using cleaners as recommended by manufacturer. During application, protect surrounding areas from over spray. Traffic, pedestrian or vehicular, shall be kept off of sealed pavers until initial cure time has been achieved.

3.6 FIELD QUALITY CONTROL

- A. After sweeping surface clean, check final elevations for conformance to Drawings.
- B. Ensure installation provides for proper drainage (1 percent) while is still ADA wheelchair compliant (i.e. no more than 1.5 percent).

---End of Section---

**SECTION 32 84 00  
PLANTING IRRIGATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Automatically-controlled irrigation system, including piping, drip emitters, valves, controls, control wiring, fittings, electrical connections, and necessary accessories.
- B. System includes two controllers:
  - 1. Controller A is an existing 48 station controller. New work shall be integrated with Controller A.
  - 2. Controller B is a new 18 station controller that replaces an existing 12 station controller.

**1.2 RELATED SECTIONS**

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.

**1.3 QUALITY ASSURANCE**

- A. Criteria:
  - 1. Manufacturer regularly and presently manufactures items submitted as one of their principal products.
  - 2. There is a permanent service organization, maintained or trained by manufacturer, which will render satisfactory service within eight hours of receipt of notification that service is requested.
  - 3. Installer, or supplier of a service, has technical qualifications, experience, and trained personnel and facilities to perform specified Work.
- B. System Requirements:
  - 1. Full and complete coverage is required. Make necessary adjustments to layout required to achieve full coverage of irrigated areas.
  - 2. This system is designed to work at available pressure. Notify the COR immediately of any discrepancies.
  - 3. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets, and fittings are not shown. Lines are to be common trenched wherever possible.
  - 4. Locations of remote control valves is schematic. Remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads.
  - 5. SPEC WRITER NOTE: Select one of the #4 paragraphs appropriate to installation in either cemetery or hospital.
  - 6. Irrigation lines and control wire shall run through designated utility lanes or beside roadways where most appropriate.
  - 7. Connect new pipe systems to existing mains where shown and specified. Disconnect and abandon existing irrigation system to be abandoned.
  - 8. Connect existing and new RCV wires to new controllers where shown and as specified as accepted by Resident Engineer.
  - 9. Install equipment indicated both on drawings and as recommended by manufacturer for an operational and functioning drip system. This includes flushing end valves, check valves, and visual pop-up indicators.
- C. Maintenance and Operating Instructions: Prior to final acceptance, verbal instructions, for a period of not less than 8 hours, shall be provided to operating personnel. Provide two additional years of software support for one hour each month.

- D. Completely program existing controller and satellites according to approved irrigation schedule. Make continuous adjustments to programming as required from irrigation installation completion to the end of the Maintenance Period. Plants shall not be overwatered resulting in plant health issues, or drainage issues. Bring any irrigation issues immediately to the attention of the COR.
- E. Manufacturer of Control Systems to certify Control System is complete, including related components, and totally operational. Submit certificate to COR.
- F. As-Built Record Drawings: Maintain a complete set of as-built drawings which shall be corrected daily to show changes in locations of pipe, valves, pumps, and related irrigation equipment. Valves shall be shown with dimensions to reference points.
- G. Controller Chart:
  - 1. Consolidate information from existing system (to remain) with new system.
  - 2. Prepare a map diagram showing location of valves, lateral lines, and route of control wires. Identify valves as to size, station, and number and type of irrigation. "As-built" drawings must be approved before charts are prepared.
  - 3. Provide one 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 actual "as-built" system. If controller sequence is not legible when drawing is reduced to door size, drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container, inside controller door.
  - 4. 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 prior to final inspection of the irrigation system.

#### 1.4 SUBMITTALS

- A. Manufacturer of Control Systems to certification that Control System is complete.
- B. Manufacturers' Literature and Data:
  - 1. Piping.
  - 2. Jointing materials.
  - 3. Valves.
  - 4. Frames and covers.
  - 5. Strainers
  - 6. Pressure gauges.
  - 7. Automatic control equipment.
  - 8. Irrigation Emitters: Pop-up spray, Bubblers, Drip Emitters, etc.
  - 9. Drip Emitters
  - 10. Quick couplers.
  - 11. Valve boxes.
  - 12. Drip pop-up indicator valve
- C. "As-built" drawings consisting of a hard copy in original scale, an electronic pdf file, and an electronic CAD file in conformance with the VA standards. Name and address of a permanent service organization maintained or trained by manufacturers that will render satisfactory service within eight hours of receipt of notification that service is requested.
- D. After "as-built" drawings have been approved, submit print of controller chart.
- E. Submit controller timing schedule showing time settings for each automatic control valve.

#### 1.5 REFERENCE, CODES, AND STANDARDS

- A. Project shall follow most stringent and current following 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. National Fire Protection Association (NFPA) 24, Section 10.4 Depth of Cover
6. Underwriters Laboratories (UL): Electrical wiring, controls, motors and devices, UL listed and so labeled.

## 1.6 REFERENCES

- A. American Society For Testing And Materials (ASTM):
  - D1785-12 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
  - D2464-13 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
  - D2466-06 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
  - D2564-12 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
  - D2855-96(2010) Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
- B. American Water Works Association (AWWA):
  - C500-09 Metal-Seated Gate Valve for Water Supply Service
- C. Manufacturers Standardization Society (MSS):
  - SP-70-2011 Gray Iron Gate Valves, Flanged and Thread Ends

## PART 2 - PRODUCTS

### 2.1 PIPING

- A. Irrigation Mains: Polyvinyl Chloride, Schedule 40, solvent welded.
- B. Irrigation Laterals: Polyvinyl Chloride, Schedule 40, solvent welded.
- C. Threaded Pipe: Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints.
- D. Above Grade and in Concrete Pit: AWWA C115, flanged joints and fittings working pressure 1025 kPa (150 psi).
- E. Fittings:
  1. Irrigation Mains (Ductile Iron and PVC Pipe): Ductile Iron, AWWA C110.
  2. Irrigation Laterals: PVC, schedule 40, solvent welded socket type, ASTM D2466.
  3. Threaded Pipe: PVC, schedule 80, ASTM D2464.
  4. Swing Joints: Threaded fittings with elastomeric seals that allow 360 degree rotation, and designed for minimum 1375 kPa (200 psig) working pressure.
- F. Jointing Materials:
  1. Irrigation Laterals: Solvent cement, ASTM D2564.

### 2.2 VALVES (EXCEPT REMOTE CONTROL VALVES)

- A. Underground Shut-Off Valves: Provide One of the Following:
  1. Gate valves (4 inches (100 mm) and larger): Epoxy-coated, cast iron body with ring-tite connections, resilient wedge disc, stainless steel non-rising stem and cast iron hand wheel, 200 psi (1380 kPa) minimum working pressure. AWWA C500.

2. 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.
- B. Operations:
1. Underground: furnish valves with 50 mm (2 inch) nut for T-Handle socket wrench operation.
  2. Above ground and in pits: MSS SP-70, with handwheels.
  3. Ends of valves shall accommodate type of pipe installed.
- C. Check: Swing.
1. Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or B62, 850 kPa (125 pound) WSP.
  2. One hundred mm (4 inches) and larger: Iron body, bronze trim, vertical or horizontal installation, flange connection, 1375 kPa (200 pound) WOG.
- D. Pressure Reducing Valve: Cast steel body with renewable seats, with stainless steel trim. Flow passages and parts designed to withstand high velocity applications, flange connected.

### 2.3 VALVE BOX

- A. Valve boxes shall not be placed in pavement.
- B. Valve boxes to have bolt down lids. Provide tamper proof bolts for lids.
- C. Gate Valve: When in pavement, valve boxes shall be precast concrete (from Rigid Cast Iron Forms) with compressive strength of concrete in excess of 30 Mpa (4000 psi). In planter areas, valve boxes shall be HDPE box, black in color. Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Mark box cover to differentiate between lawn irrigation system and domestic water supply system and set flush with finished grade. Provide 2 "T" handle socket wrenches of 15 mm (5/8 inch) round stock with sufficient length to extend 600 mm (2 feet) above top of deepest valve box cover.
- D. Remote Control Valves: When in pavement, valve boxes shall be precast concrete (from Rigid Cast Iron Forms) with compressive strength of concrete in excess of 30 MPa (4000 psi). In planter areas, valve boxes shall be HDPE structural foam Type A, Class III, black in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged cast iron cover.
1. Permanently mark valve box lid with 2-inch black valve number and controller letter or with numbered metal tag inside box as approved by Resident Engineer.
  2. Furnish 2 750 mm (30 inch) long valve adjustment keys.
- E. Drip zone Lateral Flush Cap Assembly: Round reinforced plastic valve box and lid constructed from HDPE. Opening at top of access box to be 14.5 cm (5-3/4 inches) diameter, minimum. Height of access box to be 23cm (9-1/16 inches), minimum. Lid to have lift-hole for opening.
- F. Provide and install wire mesh at bottom of valve boxes to prevent gopher intrusion.

### 2.4 STRAINERS

- A. Basket or "Y" type with brass strainer basket. Body smaller than 70 mm (2-1/2 inches) shall be brass or bronze; 70 mm (2-1/2 inches) and larger shall be cast iron or semi-steel. Strainer cover to be furnished with blow-off connection and shut-off valve to accommodate 20 mm (3/4 inch) diameter hose connection.

### 2.5 PRESSURE GAGES

- A. ANSI B40 .100, 114 mm (4-1/2 inches) diameter, metal case, bottom connected. Dial shall be either dead black or white lacquered throughout. Provide shut-off cocks. Maximum graduations of 10 kPa (2 psi).

2.6 FLOW METER

- A. Housing to be a Sch 80 polyvinyl chloride tee or bronze tee.
- B. Have a pulsing output which operates at 9VDC and a pulse rate which is proportional to the GPM.
- C. Fully compatible with the internal interface at each field controller.
- D. Powered by the controller.
- E. Replaceable metering insert.
- F. Output wire shall be underground 14 AWG feeder wire.
- G. Flow meter data can be accurately read by the controller up to 2,000 feet.
- H. Fully compatible with manufacturer of the irrigation controller.
- I. Shall feature a six-bladed design with a proprietary, non-magnetic sensing mechanism.

2.7 RAIN MEASUREMENT DEVICE

- A. Compatible with Controller, WeatherTRAK Rain Sensor WT-WRS, or approved equal.

2.8 AUTOMATIC CONTROL EQUIPMENT—INDEPENDENT ELECTRIC CONTROLLERS

- A. Model: WeatherTRAK ET Pro3 Smart Water Manager WTPRO2S-C-48-SPH, CIM-5YA Product as manufactured by Hydpoint.
- B. Control System shall consist of an Independent controller, Flow Meter, master valve and accessories necessary to operate the irrigation system.

2.9 CONTROLLER ENCLOSURE PAD

- A. Controller enclosure mounting pad assembly shall consist of a reinforced plastic support base, a 3/16-inch thick 5052 H 32 Marine grade aluminum mounting pad and stainless steel fastening brackets.

2.10 REMOTE CONTROL VALVES

- A. Provide Isolation Valve upstream from each group of control valves.
- B. Each irrigation section shall be automatically operated by a remote control valve installed underground and operated by a 24-volt AC electric solenoid valves shall be of heavy duty construction and shall have manual shut-off and flow control adjustment and provide for manual operation. Install valves with union on one side to allow for easy removal. Valves shall have a minimum of 1025 kPa (150 psi) working pressure.
- C. Valve body shall be cast-iron with brass bonnet, trim and renewable seat and have two inlet tapings (furnished with one plugged) to allow installation as either a straight or angle pattern valve.
- D. Valves shall be diaphragm type designed to operate in water containing sand and debris, without the use of scrubbers or filters. To ensure this, flush rod shall be tapered to vary the size of port opening as diaphragm raises and lowers, thus allowing trapped material to escape. Rod to be finished with a serrated surface to help scrub trapped material out. Effective diaphragm working area/valve seating opening ratio must be a minimum of 3 to 1. Valves shall be completely serviceable from the top without removing valve body from the system. Furnish 2 750 mm (30 inch) long adjustment keys. Valves to operate at no more than 50 kPa (7 psi) pressure loss at manufacturers maximum recommended flow rate.

2.11 IRRIGATION EMITTERS

- A. Entire internal assembly including filter screen, to be capable of removal from the top without removing the sprinkler case from the riser.
- B. Rotator Pop-up Sprays: Rotator to have multi-trajectory rotating stream delivery system. Body shall be pressure compensating at 40 psi and constructed of corrosion and UV resistant heavy-duty ABS. Body to have factory installed drain check valve capable of checking up to 14 feet in elevation change. Nozzles are shall have fully adjustable arcs

and radius reduction up to 25 percent. Nozzle distances shall reign from 8 to 30 feet with corner, side strips and corner side strips. Precipitation rate to be below 0.5 inch per hour at head-to-head coverage.

- C. Shrub Spray Heads: Bodies to have an internal flow regulation in the pop-up stems at 30 PSI. Pop-up stem to have a shutoff device restricting water loss by 99 percent if the nozzle is removed or damaged. Body shall include a check valve to prevent low head drainage up to 10 feet in elevation change. Nozzles shall have a precipitation rate of 1 inch per hour or less. Nozzles shall include a wide variety of arcs including 60, 120, 150, 210, 240 degrees, side strip, left and right corner strips. Nozzles shall match precipitation rate within each size and with other sizes. Nozzles shall be capable of achieving a minimum of 70 percent DU at standard head-to-head spacing. Sprinkler body, stem, nozzle, and screen shall be constructed of heavy-duty, ultraviolet resistant plastic, shall have a heavy duty stainless steel retract spring, and a ratcheting system for alignment of the pattern. Sprinkler shall have a soft elastomer pressure-activated co-molded wiper seal for cleaning debris from the pop-up stem.
- D. Sub Surface Drip Emitters
  - 1. Drip emitters shall be of pressure compensating, permanently assembled type. Emitters shall be evenly spaced inside of tubing, and be capable of providing 1gph at inlet pressures between 15 and 50 psi.
  - 2. Drip line 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).
  - 3. Drip line tubing with emitters shall be manufactured with root intrusion technology.
- E. Drip Flush Valve:
  - 1. UV resistant polyethylene materials with a minimum pressure rating of 50
- F. Drip system operation indicator
  - 1. Drip system operation indicator to be a visual pop-up indicator. Install one indicator per drip circuit and per manufacturer's recommendation.
- G. 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 drip line tubing.

## 2.12 QUICK COUPLERS

- A. Shall have 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.
- D. Furnish 2 hose swivels and operating keys for each size coupler to the COR.

## 2.13 LOW VOLTAGE CONTROL VALVE WIRE

- A. Wire: Solid copper wire, Underwriters Laboratories Inc. approved for direct burial in ground. Gage of wire shall be in accordance with manufacturer's recommendations, but in no case less than No. 14.
- B. Multi-strand cable, Underwriters Laboratories Inc. approved for direct burial in ground. Gage and type of wire shall be in accordance with manufacturer's recommendations.
- C. Provide the following colors:
  - 1. Common ground wire - white
  - 2. Control wire - red
  - 3. Spare wires - yellow (provide 3 spares)
  - 4. Master valve control wire - blue
  - 5. Flow sensor - orange / black

6. Rain sensor - 18 gage, 2-conductor direct burial wire, black in color
7. Where there is more than one controller, provide a different color control wire for each controller.

2.14 SPLICING MATERIALS

- A. Epoxy waterproof sealing packet. Low voltage controller cable

2.15 SLEEVE MATERIAL

- A. PVC-1120-5DR 17, Schedule 40.
- B. White color pipe for water.
- C. Grey color pipe for wires.

2.16 WARNING TAPE

- A. Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, detectable blue with black letters and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW".
- B. TRACER WIRES
  1. No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

**PART 3 - EXECUTION**

3.1 PIPE LAYING - GENERAL

- A. Do not lay pipe on unstable material, in wet trench or when, in the opinion of COR, trench or weather conditions are unsuitable for the Work.
- B. Allow a minimum of 80 mm (3 inches) between parallel pipes in the same trench.
- C. Hold pipe securely in place while joint is being made.
- D. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.
- E. 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.
- F. Install sprinkler lines to avoid heating trenches, electric ducts, storm and sanitary sewer lines, and existing water and gas mains.
- G. Clean interior of pipe of foreign matter before installation. Keep pipe clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.
- H. Minimum cover over water mains shall be 18 inches. Control valves shall never be less than 3 inches below finished grade. Cover laterals to minimum depth of 12 inches.
- I. 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 concrete that cracks, due to settling, during warranty period.
- J. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of Work thoroughly clean fixtures, exposed materials and equipment.
- K. Warning tape shall be continuously placed 300 mm (12 inches) above sprinkler system water mains and laterals.

3.2 LAYING PLASTIC PIPE

- A. Shall be snaked in trench at least 1 meter to 100 meters (1 foot per 100 feet) 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 of teflon thread type. After joint is made hand tight (hard), a strap wrench should be used to make up to one half additional full turn.
- C. Lubrication of the joint and rubber gasket shall be done in accordance with pipe manufacturer's specifications
- D. 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.
- E. Concrete thrust blocks shall be installed where 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 pipe manufacturer's specifications and shall be of an adequate size and so placed as to take thrust created by maximum internal water pressure.
  2. Pressure tests shall not be made for a period of 36 hours following completion of pouring of the thrust blocks.

### 3.3 INSTALLATION OF SPRAY IRRIGATION AND QUICK COUPLERS

- A. Install irrigation and quick couplers at ground surface as detailed.
- B. Place part circle sprinkler heads minimum 1 inch (25 mm), but not over 2 inches (50 mm) for turf and 6 inches (150 mm) for shrubs from edge of, and flush with top of adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation
- C. Set sprinkler heads in turf to allow for settlement. Adjust as required after settlement. Hold heads 2 inches clear of pavement edge.
- D. Install shrub sprays, sprinklers, and quick couplers on swing joints as detailed on plans.

### 3.4 DRIP EMITTER TUBING INSTALLATION

- A. Thoroughly flush lateral lines before installing drip emitter tubing.
- B. Install as per manufacturer's recommendations.
- C. Install drip emitter tubing with direct-attached emitters 2 to 4 inches (50 to 100 mm) below grade, stake down every four feet and at every fitting. Cover with a minimum 2 inches (50 mm) of mulch.
- D. Install pressure regulators and filter units in control valve boxes
- E. Adaptation from PVC Schedule 40 fittings to flex vinyl hose shall be line size by 3/8 inch (10 mm) insert bushings.
- F. Tape ends during installation and do not allow dirt or debris to enter tubing.
- G. Use fittings at sharp bends and do not allow dripper line to kink.
- H. Install a minimum two flush valves per zone at low points and ends of the zone.
- I. Use manufacturer recommended fittings for changes in direction.

### 3.5 DRIPLINE (IN LINE) TUBING INSTALLATION

- A. Thoroughly flush 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 feet and at every fitting. Cover with a minimum 2 inches (50 mm) of mulch.
- D. Install dripline in a grid pattern utilizing specified spacing. Install per VA standard detail.
- E. Install air relief valves at high points on the system.
- F. Install a minimum two flush valves per zone at low points and ends of the zone.
- G. Install a minimum two operation indicators at 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 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 changes in direction.

### 3.6 FLOW SENSOR

- A. Installation shall include sufficient pipe lengths before and after flow sensor to avoid turbulence as per manufactures specifications.
- B. Provide a 1 inch (25 mm) continuous dedicated conduit from the controller to flow sensor
- C. Install a Red and Black field wire in the dedicated conduit.
- D. Flow sensor wires shall be sealed with epoxy seal.

### 3.7 RAIN SENSOR

- A. Mount sensor on suitable post, pole, gutter, or building. Mount in location where sensor is open to rainfall and out of sprinkler spray. Sensor can be wired or wireless.

### 3.8 AUTOMATIC IRRIGATION - CONTROL SYSTEM INSTALLATION

- A. Prior to start of irrigation installation, arrange with the irrigation controller manufacturer to provide to the VA pre-installation instructions and training on proper installation and start-up of the irrigation control system.
- B. Install exterior freestanding controller on precast concrete base
- C. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- D. Install anchor bolts to elevations required for proper attachment to supported equipment.

### 3.9 INSTALLATION OF CONTROL WIRING

- A. Wiring from master controllers to satellites and stub-cuts for future extension shall be located in trench with new mains or in separate trench at back of curb, 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 with top of the bundle below top of the pipe. No two wires in any bundle shall be of the same color. Wires shall be bundled, and tied or taped at 4.5 m (15 foot) intervals. A numbered tag shall be provided at each end of a wire, i.e., at valve, at field located controllers and at master controller. The number at each end of wire shall be the same.
- 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 300 mm (12 inch) expansion loops in wiring at each wire connection or change in wire direction. Provide 600 mm (24 inch) loop at remote control valves.
- E. Power wiring for operation of irrigation system shall not be run in same conduit as control wiring.

### 3.10 TRACER WIRE INSTALLATION

- A. 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.
- B. 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 Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record locations of tracer wires and their terminations on project record documents.

### 3.11 EXISTING TREES

- A. Excavation in areas where 2 inch (50 mm) or larger roots occur shall be done by hand. Roots 2 inch (50mm) and larger in diameter, except directly in the path of pipe or conduit,

shall be tunneled under and shall be heavily wrapped with burlap, to prevent scarring or excessive drying.

- B. Where a ditching machine is run close to trees having roots smaller than 2 inch (50 mm) in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making clean cuts through.
- C. Where Irrigation is shown within the drip line of existing trees, determine in the field where irrigation can be installed without impacting or damaging existing roots. Layout exact proposed trench locations or equipment and review locations with the arborist and COR. Adjust the system as required to avoid damage to tree roots and as directed by the arborist and COR.
- D. Excavation within the drip line shall be done by hand only, with no exceptions unless approved or directed by the arborist.
- E. Provide the services of a certified arborist at no cost to the VA.

### 3.12 SETTING OF VALVES

- 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 gage 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.

### 3.13 SLEEVING

- A. Provide sleeving where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Sleeving to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 300 mm (12 inches) beyond edges of paving or construction.
- C. Bed sleeves with a minimum of 100 mm (4 inches) of sand backfill above top of pipe.

### 3.14 TEST AND FLUSHING

- A. Coordinate scheduling testing and observations with the COR to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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 VA at the COR's 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.
- C. notify the COR 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
- D. 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 couplings and fittings exposed
    - b. Apply the following tests after welded plastic pipe joints have cured for at least 24 hours.
      - i) Ring-Tite Main Line:  
Remove 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 hours. 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. Make tests and repairs as necessary until test conditions are met.
      - ii) Solvent Weld Main Line:  
Remove 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 hours. 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 sprinkler heads and drip system have been complete, test each remote control valve with a visual coverage/wetting pattern test in the presence of the COR, and determine if water coverage for planting areas is complete and adequate. Furnish material and perform Work required to correct any inadequacies of coverage due to deviation from Drawings. Correct any inadequate coverage.
    - b. This test shall be accomplished prior to burial of drip lines and any planting being installed.
  4. Final Inspection:
    - a. Operate controllers and automatic control valves to demonstrate complete and successful installation and operation of 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.

### 3.15 FINAL INSTRUCTIONS AND DOCUMENTATION

- A. Program controller according to approved irrigation schedule.
- B. Manufacturer of Control Systems shall certify control system is complete, including related components, and operational. Submit certificate to COR.

- 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 pipe, valves, pumps, and related irrigation equipment.
  - 2. Prepare As-Built drawings showing location of valves, lateral lines, and route of control wires.
  - 3. See 1.7C As-Built Drawings of this Section for requirements for 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 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 COR. Repeat the training at Contractor's own expense until the COR has concluded that the training has been conducted satisfactorily.
  - 2. Deliver manuals to the COR, within 10 Calendar Days of completion of work of this Section.

---End of Section---

**SECTION 32 90 00  
PLANTING**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Planting materials required for landscaping.

1.2 TESTING LABORATORY AND ADVISORY SERVICES

- A. Materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.
- B. Provide arborist inspections for protection of existing tree roots and recommendations for pruning.

1.3 RELATED SECTIONS

- A. Section 32 84 00, PLANTING IRRIGATION
- B. Sustainable design requirements and procedures including submittal requirements: Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS
- C. Procedures and requirements for managing and disposing construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT
- D. Section 01 45 29, TESTING LABORATORY SERVICES

1.4 SUBMITTALS

- A. Product Data: Manufacturer's current catalog cuts and specifications of the following:
  - 1. Fertilizers
  - 2. Tree Tie and Stake
  - 3. Tree Root Barrier
  - 4. Iron Sulfate
  - 5. Filter Fabric
  - 6. Perforated Drain Pipe
- B. Samples:
  - 1. Submit following samples along with certificates of compliance and analytical data from approved laboratory: Plants: Submit typical sample of each variety or entire quantity to site for approval by COR.
  - 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. Permeable Backfill (Filter Rock): Submit 1-pint sample.
  - 5. Imported Planting Soil: Submit 1-pint sample
  - 6. Raised Planter Backfill Mix: Submit 1-pint sample
  - 7. Lava Rock Aggregate: Submit 1-pint sample with product technical data sheet

- and lab analysis report demonstrating compliance with specified qualities
- 8. Imported Planting Sand: Submit 1-pint sample with product technical data sheet and lab analysis report demonstrating compliance with specified qualities
- 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 inches to 6 inches below finish grade and submit to an soils laboratory for evaluation of physical and chemical properties of soil including 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 degree of compliance with specified requirements. Report shall also include recommendations for modification of the soil for agricultural suitability.
- E. Subsoil Analysis
  - 1. Take one representative sample of any subgrade soil that is to receive a layer of imported planting soil over it. Laboratory report shall include subgrade soil's total combined silt and clay content for determining total desirable combined silt and clay content of final imported planting soil cover specified herein.
- F. Approval of Laboratory Report
  - 1. Upon approval of Laboratory's report by the COR, recommendations in the report shall become a part of the Specifications and quantities of soil amendment, fertilizer, and other additives shall be adjusted to conform with the report at no additional cost to the VA. Request Testing Laboratory to send one copy of test results directly to COR. Note that there is a minimum quantity of organic amendment specified elsewhere in this specification section.

#### 1.6 WARRANTY AND REPLACEMENT

- A. Pre-Emergence Weed Killer: Warrant the Work against weed growth for a period of four months after application.
- B. Warrant plants and planting to be in a healthy, thriving condition until the end of standard one year maintenance period, and deciduous trees beyond that time until active growth is evident.
- C. Replace dead plants and plants not in a vigorous condition immediately upon discovery and as directed by the COR at Contractor's expense. .

#### 1.7 DELIVERY AND STORAGE

- A. Notify the COR of delivery schedule in advance so plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
- B. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in branches and covering exposed branches.
- C. Deliver fertilizer to the site in original, unopened containers bearing manufacturer's

warranted chemical analysis, name, trade name or trademark, and in conformance with state and federal law.

- D. During delivery and protect seed from contamination.

#### 1.8 PLANT AND TURF ESTABLISHMENT PERIOD

- A. Establishment Period for plants and turf shall begin immediately after installation, with approval of the COR, and continue until the date that the Government accepts the Project or phase for beneficial use and occupancy. During Plant and Turf Establishment Period:
1. Water plants and turf 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 mulch or flood plants and turf.
  2. Turf receiving sub surface drip shall require 21 days minimum supplemental hand watering until sod is established.
  3. Prune plants and replace mulch as required.
  4. Replace and restore stakes and eroded plant saucers as required.
  5. In planting areas, remove grass, weeds, and other undesired vegetation, including root growth, before they reach a height of 75 mm (3 inches).
  6. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the COR.
  7. Provide the following turf establishments and maintenance:
    - a. Mow new lawn at least three times prior to final inspection. Begin mowing when grass is 100 mm (4 inches) high. Mow to a 65 mm (2-1/2 inch) height.
    - b. Maintain turf height during entire establishment period. Cut as frequently as growth of grass requires. Cut to a height of two inches, unless otherwise directed by the COR.
    - c. Maintain constant moisture to a depth of eight inches.
    - d. Trim edges of turf at paving and header-boards at time of second cutting, and at each later cutting.
    - e. Keep turf areas free of undesirable weeds and grasses by application of suitable selective weed killers or hand pulling.
    - f. Repair damaged areas as soon as evident.
    - g. Repair any hollow, settled or eroded areas by filling, rolling, and resodding.
  8. Remove plants that die during this period and replace each plant with one of the same size and species.
  9. 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.
  10. 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.
  11. Plant Protection and Replacement

- a. Protect areas against damage, including erosion, trespass, insects, rodents, deer, disease, etc. and provide proper safeguards, including trapping of rodents and applying protective sprays and fencing to discourage deer browsing. Maintain and keep temporary barriers erected to prevent trespass.
  - b. Repair damaged planted areas. Replace plants and reseed or resod turf immediately upon discovery of damage or loss, including damage from Deer and Rodents.
12. Fertilizing:
- a. Upon approval and after submitting fertilizer delivery tags, maintenance fertilization shall begin 30 days after planting is complete. Fertilize turf and ground cover areas by broad-casting Type C (21-7-14) fertilizer at the rate of 5 pounds per 1,000 square feet evenly throughout. Reapply every forty-five (45) days until acceptable.
  - b. During winter, for quick turf greening effect, calcium nitrate (15.5-0-0) may be applied at the rate of 6 pounds per 1,000 square feet.
  - c. Early spring and fall substitute a complete fertilizer such as 15-15-15 applied at the rate of 6 pounds per 1,000 square feet, to help insure continuing adequate phosphorus and potassium.
  - d. Apply ammonium sulfate fertilizer as necessary to maintain vigorous, green grass between fertilizations mentioned above.
  - e. 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.

#### 1.9 PLANT AND TURF WARRANTY

- A. Work shall be warranted in accordance with terms of the Paragraph, "Warranty" of FAR clause 52.246-21, additionally:
  1. Mulch and weed plant beds and saucers. Just prior to this inspection, treat these areas to a second application of approved pre-emergent herbicide.
  2. From plants having been installed for one year, remove stakes, guy wires and any required tree wrappings.
  3. Complete remedial measures directed by the COR to ensure plant and turf survival.

#### 1.10 PLANT MAINTENANCE PERIOD

- A. Once Project installation has been accepted as complete, conduct a three-month Maintenance Period. At conclusion of the Maintenance Period, schedule a final review with the COR. On such date, project improvements and corrective work shall have been completed.
- B. Submit written notice requesting review at least 10 days before anticipated review.
- C. Prior to review, weed and rake planted areas, repair plant basins, mow and edge turf, plumb tree stakes, clear site of debris, and present in a neat, orderly manner.

#### 1.11 REFERENCES

- A. American National Standards Institute (ANSI) Publications:

1. Z60.1-04 Nursery Stock
- B. Hortus Third, A Concise Dictionary of Plants Cultivated in the U.S. and Canada.
- C. US Composting Council Compost analysis Program (CAP)
- D. References to "Caltrans Standard Specifications" shall mean the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Plant material shall conform to 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 Drawings or Specifications are in conflict with ANSI Z60.1, the Drawings and Specification shall prevail.
- B. Tag plants of type or name indicated and in accordance with the standard practice recommended by the American Association of Nurserymen.
- C. Install healthy, shapely, and well rooted plants with no evidence of having been root-bound, restricted, or deformed.
- D. Ensure plants 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.
- E. Substitutions will not be permitted, except as follows:
  1. If proof is submitted to the COR 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 COR within 10 days after effective date of Notice to Proceed.
- F. 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, central leader should not have been headed; however, in cases where the original leader has been removed, an upright branch at least 1/2 the diameter of the original leader just below the pruning point shall be present.
  2. Potential Main Branches: Branches 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 inch diameter, and no greater than

1/2 diameter of the trunk at point of attachment.

G. 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 inches above the soil surface shall be within the diameter range shown for each container size below, except where shown otherwise:

4.

<u>Container</u>	<u>Trunk Dia. (inches)</u>	<u>Soil level from Container Top (inches)</u>
5 gallon	0.5 to 0.75	1.25 to 2
15 gallon	0.75 to 1.0	1.75 to 2.75
24-inch Box	1.5 to 2.5	2.25 to 3

5. Tree trunks shall be undamaged and uncut with old abrasions and cuts completely callused over. Do not prune plants prior to delivery.

H. Tree Roots

1. Trunk root collar (root crown) and large roots shall be free of circling and kinked roots. Contractor may be required to remove soil near the root collar in order to verify that circling and kinked roots are not present.
2. 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. Top-most roots or root collar shall be within 1 inch above or below soil surface. Soil level in the container shall be within the limits shown in above table.
4. 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.

I. Shrubs

1. Each shrub must stand upright without support.
2. Container shrubs shall be free of girdling roots, defined as those roots greater than 1/8 inch diameter circling the periphery of the rootball. Top of the rootball shall be free of "knees" (roots) protruding above the soil, and the bottom shall be free of matted roots.

- J. 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.

2.3 GRASS (TURF)

A. Turf Sod

1. Blends as follows
2. Tall Fescue Sod Mix (Grown on Sand)  
80 to 90 percent Dwarf-type Fescue and Tall-type Fescue  
10 to 20 percent Blue Grass

Available from Delta bluegrass (800) 637-8873

3. Machine cut sod to a uniform thickness of 3/4-inch excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends, in vigorous condition, dark green in color, free of disease, weeds and harmful insects. Broken pads, irregularly shaped pieces, and torn and uneven ends will be rejected.

## 2.4 FERTILIZERS

- A. Commercial fertilizer, pelleted or granular form, conform to requirements of Chapter 7, Article 2, of the Agricultural Code of the State of California for fertilizing materials as follows:
  1. Type A:  
6 percent Nitrogen, 20 percent Phosphorus Acid and 20 percent Potash, (6-20-20).
  2. Type B:  
21 gram planting tablets 20 percent Nitrogen, 10 percent Phosphoric Acid and 5 percent Potash (20-10-5) available from Agriform or 10gm BestPacks packets 20 percent Nitrogen, 10 percent Phosphoric Acid and 5 percent Potash (20-10-5) available from Best Fertilizer Co.
  3. Type C:  
Complete fertilizer 21 percent Nitrogen, 7 percent Phosphoric Acid and 14 percent 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 COR.
- B. Maintenance Fertilizer: Type C

## 2.5 ORGANIC AMENDMENT FOR IN SITU SOILS (ON-GRADE):

- A. Ground Redwood or Ground Fir Bark with the following properties:

1.	<u>Percent Passing</u>	<u>Sieve Designation</u>	
	100	9.51 mm	3/8 inch
	50-60	6.35 mm	1/4 inch
	20-40	4.76 mm	No. 4
	0-20	2.38 mm	No. 8

### Redwood Sawdust

Dry bulk density, lbs. per cu. yd., 260-280  
Nitrogen stabilized - dry weight basis, min. 0.4 percent  
Salinity (ECe): 4.0 maximum  
Organic Content: 90 percent 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 percent  
Salinity (ECe): 4.0 maximum  
Organic Content: 90 percent minimum  
Reaction (pH): 4.0 minimum

- B. Submit sample along with analytical data from an approved laboratory for degree of compliance to the COR within two weeks after award of Contract.

2.6 IRON SULFATE

- A. Type: Dry form.

2.7 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-inch box and larger	iron, 1 cup

- B. Mix 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.

2.8 RAISED PLANTER BACKFILL MIX

- A. "Raised Planter Backfill Mix" is a mixture 35 percent Tree & Shrub Planter/Plaster Sand, 35 percent lava rock, and 30 percent nitrolized Fir Bark Organic Amendment, and fertilizer ingredients listed below.
- B. Raised Planter Backfill Mix shall be delivered to the site in a damp condition and installed immediately to prevent losing humus due to wind blow.
- C. Include fertilizer ingredients as follows:
  - 0.75 pound Potassium Nitrate 13-0-44
  - 0.5 pound Calcium Nitrate 15.5-0-0
  - 0.5 pound Urea Formaldehyde 38-0-0
  - 2.5 pounds Single Superphosphate 0-25-0
  - 4.0 pounds Calcium Carbonate Lime
  - 4.0 pounds Kaiser 65 Dolomite
  - 1.0 pounds Iron Sulfate (min. 20 percent Fe)

2.9 LAVA ROCK AGGREGATE

- A. Lava Rock Aggregate, Required Properties:
  - 1. Grain Size Distribution

<u>U.S. Std. Sieve Size</u>	<u>Percentage Weight Passing-Cumulative</u>
12.5mm	95-100
8 mm	90-100
4.75 mm (#4)	35-50
1.18 mm (#16)	0-20

0.850 mm (#20)	0-20
0.500 mm (#35)	0-20
0.212 mm (#70)	0-20
0.150 mm (#100)	0-15
0.075 mm (#200)	0-5
.053 mm (#270)	0-5
.045 mm (#325)	0-5

2. Sieve Analysis by ASTM 136
3. PH - 6.0 to 7.8
4. Chloride ppm 9.5 to 19
5. Sulfate ppm .4 to 1.1
6. Absorption 15 to 30 percent
7. Loose Unit Weight 43 pounds PCF (ASTM C 29)
8. Absorption: Lava Rock aggregate shall retain a minimum of 18 percent of its weight in absorbed water and shall be free of toxic materials, insects, diseases, weed seeds, and other pests.
9. Sieve analysis shall be as shown above and with not more than 5 percent passing the #200 sieve. Lava Rock Aggregate meeting the above specification is available from American Soil Products, Richmond, CA (510) 292-3000 and TMT Enterprises, San Jose, CA (408) 432-9040.

2.10 IMPORTED PLANTING SAND

- A. 100 percent medium/coarse, washed, sharp, angular, silt-free sand
- B. Sieve analysis:

Component	size	Sieve #	% Retained	% Passing
Gravel	4.76 mm	4	0	100
Fine Gravel	2.00 mm	10	0-5	95-100
Very Coarse Sand	1.00 mm	18	0-10	90-100
Coarse Sand	500 micron	35	0-35	65-100
Medium Sand	250 micron	60	50-100	0-50
Fine Sand	105 micron	140	0-30	0-20
Very Fine Sand	53 micron	270	0-15	0-5
Silt and Clay		Pan	0-5	

- C. Reaction (pH) of the saturated sand shall be between 6.0-8.0 as determined on the saturation extract solution:
- D. Permissible range of Salinity, Boron and Sodium as follows:
  1. Salinity (Ece) 0-3.0 dS/m

2. Boron 0.1.0 ppm
3. Sodium 0-20 meq/L

#### 2.11 MULCH

- A. Organic Mulch: Natural fir tree bark mulch; 3/4-inch to 1-inch size.
- B. Submit samples of organic and rock mulches to the COR for approval within two weeks of award of Contract. Resubmit until acceptable to COR, at no extra cost.

#### 2.12 TREE SUPPORT POLES

- A. Support Poles for trees up to 36 inch box size.
- B. Type: Peeled lodge pole pine logs, clean, smooth, new, and sized as follows:
  1. Two-inch diameter by eight feet long for trees less than 8 feet high or 1 inch caliper.
  2. Three-inch diameter by eight to ten feet long for trees greater than 8 feet high or 1 inch caliper.

#### 2.13 TIES

- A. Rubber strap, 24-inch minimum length without sharp edges adjacent to trunk.

#### 2.14 TREE ROOT BARRIER

- A. Root Barrier shall be black injection molded panels of 0.080 inch wall thickness in modules 24 inch long by 18 inch deep manufactured with a minimum 50 percent post-consumer recycled polypropylene plastic with added ultraviolet inhibitors, recyclable.
- B. Each panel shall have not less than four molded integral vertical root deflecting ribs of at least 0.06 inch thickness protruding 1/2 inch at 90 degrees from interior of the barrier panel, spaced 6 inches apart. A double top edge consisting of two parallel, integral, horizontal ribs at the top of the panel of a minimum 0.06 inch thickness 3/8 inch wide and 1/4 inch apart. A minimum of 9 anti-lift tabs consisting of integral horizontal ridges of a minimum 0.06 inch thickness.
- C. Panels shall have an instant assembly system by sliding one panel into another.

#### 2.15 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 inches in diameter, and without weeds, roots, and other objectionable material.

#### 2.16 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. 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 percent to 40 percent 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 COR 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 sample to the COR two weeks before starting hauling of the soil. Following approval of the sample, provide a 1/2 cubic yard sample, which shall be stored at the site of work for comparison with subsequent loads of soil. Comparison sample shall be protected by a cover until furnishing of soil has been completed and accepted. Should soil submittal lack certain requirements which can be added to the soil, the COR will consider a request by the Contractor to amend the soil as recommended by the Soils Analyst at the Contractor's expense.

#### 2.17 PRE-EMERGENCE WEED KILLER

- A. Clean non-staining as recommended by a licensed pest control specialist.

#### 2.18 FILTER FABRIC

- A. Needle punched nonwoven geotextile Filter Fabric composed of polypropylene fibers, which are formed into a stable network such that fibers retain their relative position. Inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids weighing 18 grams per square meter. Meets Aashto M288-06 Class 3 for elongation > 50 percent.

#### 2.19 PIPE

- A. Polyvinyl Chloride (PVC) pipe and pipe fittings shall meet extra strength minimum of SDR-35 of requirements of ASTM Specification D3034.
- B. Perforated and non-perforated corrugated polyethylene pipe, 3- to 10-inch diameter, shall meet requirements of ASTM D883 and ASTM F412, and shall conform to Section 68 of the Standard Specifications.
  - 1. Corrugated polyethylene pipe fittings shall comply with requirements of AASHTO M-252-85I for 3 to 10-inch diameter pipe. Couplings shall be split or snap-on type for perforated pipe and split couplings with gaskets for non-perforated pipe. Cutting pipe with integral couplings will not be allowed.
  - 2. Corrugated polyethylene pipe and fittings manufactured by Advanced Drainage Systems, Inc., shall be considered the standard to determine compliance to this specification.

#### 2.20 PERMEABLE BACKFILL (FILTER ROCK)

- A. Permeable backfill used in subsurface drain installations to be Class 2 permeable material in conformance with Section 68 "Subsurface Drains" of the Caltrans Standard Specifications; gradation to 3/4 inch maximum size. Submit Sample for approval.

#### 2.21 ALUMINUM EDGING

- A. 3/16 inch by 4 inch by 8 feet black anodized finish with 12 inch minimum long stakes set

1/2 inch below grade at each joint and maximum 4-foot spacing, in-line joints without offset or double thickness.

### **PART 3 - EXECUTION**

#### **3.1 FINE GRADING AND SOIL PREPARATION**

- A. Perform planting operations after irrigation system is installed, tested, and approved.
- B. Soil in 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 percent. Rip and scarify and dry any areas that do not meet this requirement.
- C. No work shall be done when 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 COR stating the special conditions and proposal variance.
- D. Test subgrade in 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 COR.
- E. 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 the COR. Field measure and record 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.
- F. Planting Soil Placement:
  - 1. Inspect planting areas and remove base rock and other foreign material. Verify placement of planting soil within dripline of trees with COR. Except within tree driplines, rip 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 COR to the specified depth to ensure proper percolation/drainage.
  - 2. Prior to placing planting soil secure the COR acceptance of the planting areas subgrade condition. Test depth of loose soil with hand shovel in presence of the COR 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 percent 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-inch depth in planting areas, or more where shown or specified otherwise.
- G. Planting Soil Placement in Planting Islands and Adjacent to Pavement Areas:

1. Provide planting soil as a final lift in 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 engineered fill, base rock, and compacted subgrade full depth of compaction and replace with approved planting soil, a minimum lift of 12 inches. Unless shown otherwise, finish grade in planting islands shall be crowned with a minimum 2 percent pitch to the edges.
- H. 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.
- I. Planting operations shall be performed only during periods when beneficial results can be obtained.
- J. Thoroughly wet down planting areas to settle the soil and confirm irrigation coverage and operation. Allow soil to dry so as to be workable as described herein.
- K. Drag to a smooth, even surface. Grade to form 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.
- L. Finish Grade: Hold finish grade and/or mulch surface in planting areas 1/2-inch below adjacent pavement surfaces, tops of curbs, manholes, etc. 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. Remainder of the planting area shall be graded to receive the required 3-inch layer of mulch.
- M. In Situ Soil Preparation:
  1. Spread organic amendment, iron and Type A fertilizer evenly over installed and rough graded topsoil in 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 pounds per 1,000 square feet.
    - c. Iron Sulfate: 10 pounds 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 rust damage to work.
  3. Planting soil shall have a pH range of 6.5 to 7.5.
- N. After rototill work, float areas to a smooth, uniform grade as indicated on Drawings. Slope 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 COR before any planting.
- O. Notify the COR immediately if any planting soil areas have standing water or fail to drain properly prior to plant installation. Review on site with the COR.

### 3.2 ALUMINUM EDGING

- A. Install in continuous strips as indicated and in accordance with manufacturer's recommendations with stakes spaced 48 inches on center maximum and at joints.

### 3.3 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 COR 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 COR prior to planting. If Subsurface drip is installed, adjust plant locations in relation to the subsurface emitter as required to ensure that 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 inches). Retention of water in planting beds and plant pits for more than two hours shall be brought to the attention of the COR. If rock, underground construction work, tree roots, poor drainage, or other obstructions are encountered in excavation of plant pits, alternate locations may be selected by COR.
- 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 inches 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 inches 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 COR'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 COR. Replace damaged tree as determined by the COR. If replacement is not necessary, prune damaged branches as directed by the COR and under 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 plant establishment period.

### 3.4 TREE, SHRUB AND VINE 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 the COR, 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.

### 3.5 GROUND COVER PLANTING

- A. Plant in neat, straight, parallel and staggered rows as indicated on plan. Plant first row at 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.

### 3.6 SODDED TURF

- A. Lightly roll surface and re-shape to level humps and hollows. Secure Landscape Architect's approval prior to sodding. Do not sod on dry soil.
- B. Lay first strip of sod along a straight line (use a string in irregular areas). Butt joints tightly, do not overlap edges. On second strip, stagger joints. Use a sharp knife to cut sod to fit curves, edges and sprinkler heads.
- C. When a conveniently large area has been sodded, water lightly to prevent drying. Continue to sod and to water until installation is complete.
- D. After laying sod, roll lightly to eliminate irregularities and to form good contact between sod and soil. Avoid a heavy roller and excessive initial watering.
- E. Thoroughly water completed sod surface to at least 8 inches deep. Repeat sprinkling at regular intervals to keep sod moist at all times until rooted. After sod is established, decrease frequency and increase amount of water per application.
- F. Turf with subsurface drip irrigation shall require 21 days minimum supplemental hand watering until sod is established.
- G. Protect turf areas by erecting fences, barriers and signs necessary to prevent trespass. Keep barriers neat and well maintained.

### 3.7 MULCH

- A. Except where rock mulch is required, mulch 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 inches or as directed by the COR. Individual trees and/or shrubs planted in non-irrigated areas shall, at minimum, receive bark mulch over their watering basin and berm. No mulch is required around trees in bioswales or bioretention basins.
- B. Install rock mulch to a minimum 3-inch depth where shown.

### 3.8 ROOT BARRIER

- A. Install in linear fashion along and adjacent to the edges of planting area as detailed or, if not shown, in accordance with manufacturer's recommendations.

### 3.9 PRE-EMERGENCE WEED KILLER

- A. Apply pre-emergence weed killer in areas to receive ground cover planting. Work shall

be done under 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 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.

--- End of Section ---

**SECTION 33 10 00  
WATER UTILITIES**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Underground water distribution system complete, ready for operation, including appurtenant structures, and connections to both new building service lines and to existing water supply.

1.02 RELATED SECTIONS

- A. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Protection of materials and equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Fire protection system connection and supervisory switch for post indicator valve: Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- E. Fire protection system connection, Section 21 10 00, WATER-BASED FIRE-SUPPRESSION SYSTEMS.

1.03 DEFINITIONS

- A. Water Distribution: Pipelines and appurtenances which are part of distribution system. Distribution system comprises the network of piping located throughout building areas and other areas of water use, including hydrants, valves, and other appurtenances used to supply water for domestic and fire-fighting/fire protection purposes.
- B. Water Service Line: Pipe line connecting building piping to water distribution lines.

1.04 QUALITY ASSURANCE

- A. Comply with rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.
- B. Comply with rules and regulations of Federal, State, and Local Health Department having jurisdiction over the design, construction, and operation of potable water systems.
- C. Material surfaces in contact with potable water shall comply with NSF 61.

1.05 SUBMITTALS

Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

- A. Manufacturers' Literature and Data (Submit items as one package):

1. (Ductile Iron Pipe and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and C605 respectively; and shall be provided to Resident Engineer for approval.)
2. Piping.
3. Gaskets.
4. Valves.
5. Fire hydrants.
6. Street washer.
7. Meter.
8. Vaults, frames and covers.
9. Steps.
10. Post indicator.
11. Valve boxes.
12. Corporation and curb stops.
13. Curb stop boxes.
14. Joint restraint.
15. Disinfection products.
16. Link/sleeve seals.

B. Testing Certifications:

1. Certification of Backflow Devices.
2. Hydrostatic Testing.
3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

1.06 REFERENCES

A. American National Standards Institute (ANSI/ASME):

1. B16.1-98 Cast Iron Pipe Flanges and Flanged Fittings
2. B16.18 Cast Bronze Solder Joint Pressure Fittings

B. American Society for Testing and Materials (ASTM):

1. A242-00 Standard Specifications for High Strength Low Alloy Structural Steel  
AASHTO No. M161
2. A307-02 Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi  
Tensile Strength
3. A536-04 Standard Specifications for Ductile Iron Castings
4. B61-02 Steam or Valve Bronze Castings
5. B62-02 Composition Bronze or Ounce Metal Castings

6. B88-02 Seamless Copper Water Tube
7. C139-03 Concrete Masonry Units for Construction of Catch Basins and Manholes
8. D2464-99 Standard Specifications for Threaded PVC Pipe Fittings, Schedule 80

C. American Water Works Association (AWWA):

1. B300-04 Hypochlorites
2. B301-04 Liquid Chlorine
3. C104-04 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
4. C105-99 Polyethylene Encasement for Gray and Ductile C.I. Piping for Water and Other Liquids
5. C110-03 Ductile-Iron and Gray-Iron Fittings, 80 mm (3 Inches) Through 1200 mm (48 Inches) for Water and Other Liquids
6. C111-01 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
7. C115-99 Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
8. C150-02 American National Standard for Thickness Design of Ductile Iron Pipe
9. C151-96 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
10. C153-00 Ductile-Iron Compact Fittings, 80 mm (3 inches) Through 300 mm (12 Inches) for Water and Other Liquids
11. C503-97 Wet-Barrel Fire Hydrants
12. C508-01 Swing Check Valves for Waterworks Service, 2 Inches (50 mm) Through 24 Inches (600mm) NPS
13. C509-01 Resilient Seated Gate Valve for Water and Sewage System
14. C510-97 Double Check Valve Back-Flow Prevention Assembly
15. C511-97 Reduced Pressure Principle Back-Flow Prevention Assembly
16. C550-01 Protective Epoxy Interior Coatings for Valves and Hydrants
17. C600-01 Installation for Ductile-Iron Water Mains and Their Appurtenances
18. C605-94 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
19. C651-92 Disinfecting Water Mains
20. C800-01 Underground Service Line Valves and Fittings
21. C900-97 Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Thru 12 Inches, for Water

D. NSF International:

1. 61-02 Drinking Water System Components-Health Effects (Sections 1-9)

- E. American Welding Society (AWS):
  - 1. A5.8-04 Brazing Filler Metal
  - 2. Foundation for Cross-Connection Control and Hydraulic Research-2005
  - 3. Copper Development Association's Copper Tube Handbook-2005

## **PART 2 - PRODUCTS**

### **2.01 DUCTILE IRON PIPE AND FITTINGS**

- A. Ductile iron pipe, direct buried:
  - 1. Provide ductile iron pipe conforming to requirements of AWWA C151, Pressure Class 350 for Pipe 100 mm through 300 mm (4 inches through 12 inches) in diameter and 250, with standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.
  - 2. Below Grade: Supply pipe in lengths not in excess of a nominal 6 m (20 feet) with rubber ring type push-on joints, mechanical joint or approved restrained joint. Provide flange joint pipe where shown on Drawings. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.
  - 3. When a polyethylene encasement over pipe, fittings, and valves is a requirement as indicated on Drawings, material, installation and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.
- B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:
  - 1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter. Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 850 kPa (125 psi) or 1725 kPa (250 psi) standard, for the purpose intended.
  - 2. Wall Sleeve Castings: Size and types shown on Drawings and be hot dipped galvanized.
  - 3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for flanged pipe.
  - 4. Rubber Ring Gaskets: Full face type, AWWA C111, 2 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.
  - 5. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop primed on the outside. Paint color shall match the wall color.
  - 6. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.
- C. Pipe Fittings: Ductile iron with a minimum pressure rating of 2400 kPa (350 psi). Fittings shall meet requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings

shall conform to AWWA C115 and be furnished flat faced and drilled to 850 kPa (125 psi) or 1725 kPa (250 psi) template in accordance with ANSI B16.1 with full faced gaskets.

- D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.
- E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for pipe in accordance with AWWA C151.
- F. Provide non-detectable adhesive backed identification tape on top and sides of buried ductile iron pipe, extended from joint to joint along the length of pipe and have black lettering identifying pipe service at no more than 300 mm (12 inch) intervals. According to service, tape background color shall be as follows: potable water-blue.

## 2.02 POLYVINYL CHLORIDE PIPE AND FITTINGS

### A. Class-Rated Polyvinyl Chloride (PVC) Pipe:

- 1. PVC pipe and accessories 100 mm to 356 mm (4 inches–14 inches) in diameter, AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe", Class 305, DR 14, cast iron outside diameters, unless otherwise shown or specified.
- 2. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting requirements of ASTM D-1785, Type 1, Grade 1. Exposed piping shall be CPVC meeting requirements of ASTM F441.

### B. Joints:

- 1. Pipe 75 mm (3 inches) and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting requirements of ASTM F-477.
- 2. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D-2464) or solvent welded (ASTM 2467). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on threaded joints.

### C. Fittings:

- 1. Class-Rated Pipe 75 mm (3 inches) in Diameter and Greater: Ductile iron with mechanical joints conforming to requirements of AWWA C153.
- 2. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

## 2.03 COPPER PIPE AND TUBING

- A. Copper Piping: ASTM B88, Type K, or Type L with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8, Classification BCuP.

## 2.04 VALVES

- A. Asbestos packing is not allowed.

B. Gate:

1. 75 mm (3 inches) and Larger: Resilient seated, ductile iron body, bronze mounted, inclined seats, non-rising stem type turning counter-clockwise to open, 1375 kPa (200 pound) WOG. AWWA C509. Resilient seat shall be fastened to the gate with stainless steel fasteners or vulcanizing methods. Interior and exterior shall be coated with thermo-setting or fusion epoxy coating in accordance with AWWA C550.
2. Operator:
  - a. Underground: Except for use with post indicators, furnish valves with 50 mm (2 inch) nut for socket wrench operation. Post indicator shall comply with requirements of NFPA 24 and shall be fully compatible with the valve provided.
  - b. Above Ground and in Pits: Hand wheels.
3. Joints: Ends of valves shall accommodate, or be adapted to, pipe installed.

C. Check: Swing.

1. Smaller than 100 mm (4 inches): Bronze body and bonnet, ASTM B61 or B62, 1375 kPa (200 pound) WOG.
2. 100 mm (4 inches) and Larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1375 kPa (200 pound) WOG. Check valves for fire lines shall conform to AWWA C508 and shall be epoxy coated and lined per AWWA C550.

D. Corporation stops and saddles shall conform to AWWA C800.

E. Curb Stop: Smaller than 75 mm (3 inches). Waterworks standard for Type "K" copper, single piece cast bronze body with tee top operated plug sealed with O-ring gaskets, 1375 kPa (200 pound) WOG per AWWA C800.

2.05 CURB STOP BOX

- A. Cast iron extension box with screw or slide type adjustment and flared base. Box shall be adapted, without full extension, to depth of cover required over pipe at stop location. Cast the word "WATER" in cover and set cover flush with finished grade. Curb stop shut-off rod shall extend 600 mm (2 feet) above top of deepest stop box.

2.06 VALVE BOX

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide "T" handle socket wrenches of 16 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box.

2.07 POST INDICATOR VALVE

- A. Valve: Valve shall conform to specifications listed in Section 2.4 for gate valves. Post Indicator shall conform to NFPA 24, and shall be fully compatible with the valve and the supervisory switches.

## 2.08 FIRE HYDRANTS

- A. Size of main valve opening of each hydrant shall be 125 mm (5 inches), minimum. Hose thread, size of fire apparatus connection, and shape, size and direction of rotation of operating head of hydrant shall be identical with present local fire department and/or water department standards those in use at station.
- B. Hydrant shall be type AWWA C503, heavy construction, of proper length to connect pipe without extra fittings, and shall be traffic type with safety flange on barrel and safety couplings on the valve stem with the following features:
  - 1. Interior removable without digging up hydrant; can be packed under pressure; 150 mm (6 inch) bell connection; one steamer nozzle and two hose nozzles with nozzle caps securely chained to barrel; suitable drainage device; single rubber or leather-faced valve in base; nozzles, stuffing boxes, wedge nuts, seat rings, clamp plates, etc. Threaded joints or spindles shall be bronze. Upper and lower barrels shall be of equal diameters. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 50 mm (2 inches) above finished grade. Fire hydrants shall have 150 mm (6 inch) bottom connection.
  - 2. Provide fire hydrants with finish paint identical to existing fire hydrants.
- C. Provide wrenches with handles not less than 350 mm (14 inches) long.

## 2.09 PIPE SLEEVES

- A. Ductile iron or zinc coated steel.

## 2.010 BACKFLOW PREVENTER

- A. Potable Water: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 100 kPa (15 psi). Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.
- B. Fire Service: Double detector check valve. AWWA C510 and NFPA 14.
- C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.
- D. Backflow preventers shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research per current edition of the Manual of Cross-Connection Control.
- E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous or corrosive.
- F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.
- G. Backflow preventer shall be accessed and have clearance for required testing, maintenance, and repair. Access and clearance shall require a minimum of one foot (305 mm) between the lowest portion of assembly and grade, floor or platform. Installations elevated more than five

feet (1524 mm) above floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

2.011 WATER METER

- A. 2 inches and smaller: positive displacement type meter, AWWA C700.
- B. 3 inches and larger: compound type meter, AWWA C702.
  - 1. Meters shall be provided with separate external bronze case strainers of stainless steel plate type on sizes 3-inch to 6-inch sizes. Strainers shall be installed upstream of the meter with a minimum length pipe spool per meter manufacturer's recommendations. Strainers shall be rigid, easily removable, and have an effective straining area at least double that of the meter main case inlet. Strainer connections shall conform to the main case and shall be accompanied by gaskets, bolts and nuts.
  - 2. Meters sets shall include isolation valves and bypass piping as shown on Plans.
  - 3. Meter sizes, capacities and pressure losses shall conform to Table 1 of the AWWA Standard. Main case lengths shall not exceed those reflected in Table 2 of the AWWA Standard.
  - 4. Main case connections shall be as shown in Table 4 of the AWWA Standard and shall be accompanied by companion flanges, gaskets, bolts and nuts of the same size as shown in Table 4 of the AWWA Standard.

2.012 VAULTS (BACKFLOW PREVENTER OR METER)

- A. Top and base shall be reinforced concrete.
- B. Walls shall be reinforced concrete, precast concrete, or segmental block (ASTM C139).

2.013 CAST IRON FRAME AND COVER, STEPS, ETC.

- A. Cast iron frame and cover, steps, etc. shall comply with State Department of Transportation standard details. Identify cover as "WATER".

2.014 **FLEXIBLE EXPANSION JOINTS: (PROVIDE FOR DOMESTIC AND FIRE SERVICE)**

- A. Ductile iron with ball joints rated for 1725 kPa (250 PSI) working pressure conforming to ANSI/AWWA A21.53/C153, capable of deflecting a minimum of 30 degrees and expanding simultaneously to the amount shown on Drawings. Flexible expansion joint shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 375 m<sup>2</sup> (15 mils) of fusion bonded epoxy conforming to applicable requirements of ANSI/AWWA C213 and shall be factory holiday tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to ANSI/AWWA A21.11/C110. Bolts and nuts high strength steel with synthetic gaskets that comply with AWWA C110.

2.015 POTABLE WATER

- A. Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.016 DISINFECTION CHLORINE

- A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.
- B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

2.017 WARNING TAPE

- A. Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, detectable type, blue with black letters, and imprinted with "CAUTION BURIED WATER LINE BELOW".

**PART 3 - EXECUTION**

3.01 BUILDING SERVICE LINES

- A. Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps.

3.02 REGRADING

- A. Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

3.03 PIPE LAYING, GENERAL

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to pipe or coatings. Pipe or fittings shall not be dropped. Pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the COR.
- B. Pipe and fittings shall be subjected to a careful inspection just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Government. Pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the Work, and when installed or laid, shall conform to the lines and grades required.
- C. Buried piping shall be installed to the lines and grades as shown on Drawings. Underground piping shall slope uniformly between joints where elevations are shown.

- D. Contractor shall exercise extreme care when installing piping to shore up and protect from damage existing underground water line and power lines, and existing structures.
- E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.
- F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.
- G. Hold pipe securely in place while joint is being made.
- H. Do not walk on pipes in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.
- I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
- J. Tees, plugs, caps, bends and hydrants on pipe installed underground shall be anchored. See section 3.7 "PIPE SUPPORTS".
- K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of Work, thoroughly clean exposed materials and equipment.
- L. Good alignment shall be preserved in laying. Deflection at joints shall not exceed that recommended by manufacturer.
- M. Warning tape shall be continuously placed 300 mm (12 inches) above buried water pipes.

#### 3.04 DUCTILE IRON PIPE

- A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement if required in accordance with AWWA C105. Provide a firm even bearing throughout length of pipe by tamping selected material at the sides of the pipe up to the spring line.
- B. Pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to manufactured spigot end. Cement lining shall be undamaged.
- D. Jointing Ductile-Iron Pipe:
  - 1. Push-on joints shall be made in strict accordance with manufacturer's instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. Plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home with approved means.

2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening bolts. Bolts shall be tightened to the specified torque.
3. Ball Joints: Install in strict accordance with manufacturer's instructions. Where ball joint assemblies occur at the face of structures, socket end shall be at the structure and ball end assembled to the socket.
4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

### 3.05 PVC PIPE

- A. PVC piping shall be installed in strict accordance with manufacturer's instructions and AWWA 605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 31 20 00, EARTH MOVING.
- B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with piping to permit location of the pipe with electronic detectors. Wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (1000 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. Solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.
- C. Magnetic markers may be used in lieu of copper tracer wire to aid in future pipe locating. Generally, install markers on 6 m (20 foot) centers. If pipe is in a congested piping area, install on 3 m (10 foot) centers. Prepare as-built drawing indicating exact location of magnetic markers.

### 3.06 COPPER PIPE

- A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations. Copper piping shall be bedded in 150 mm (6 inches) of sand and then back filled as specified in Section 31 20 00, EARTH MOVING.

### 3.07 PIPE SUPPORTS

- A. Supports:
  1. Piping shall be properly and adequately supported. Hangers, supports, base elbows and tees, and concrete piers and pads shall be provided as indicated on Drawings. If method of support is not indicated on Drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on centers and at each fitting.
  2. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on Drawings.

3. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.
4. Where hangers cannot be used, the Contractor shall provide pipe saddle supports with pipe column and floor flange.

### 3.08 RESTRAINED JOINTS

- A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1375 kPa (200 psi). Pipe and fittings shall be restrained push-on joints or restrained mechanical joints.
- B. Minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as shown on Drawings.
- C. Restrained joint assemblies with ductile iron mechanical joint pipe shall be restrained.
- D. Ductile iron pipe bell and spigot joints shall be restrained.
- E. Ductile iron mechanical joint fittings shall be restrained. Restraining device shall be designed to fit standard mechanical joint bells with standard T head bolts conforming to AWWA C111 and AWWA C153. Glands shall be manufactured of ductile iron conforming to ASTM A536. Set screws shall be hardened ductile iron and require the same torque in all sizes. Steel set screws not permitted. These devices shall have the stated pressure rating with a minimum safety factor of 2:1. Glands shall be listed with Underwriters Laboratories and/or approved by Factory Mutual.
- F. Thrust blocks shall not be permitted.
- G. Where ductile iron pipe manufactured with restrained joints is utilized, restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.
- H. PVC pipe bell and spigot joints shall be restrained. Restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting requirements of ASTM A242.
- I. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained. Restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting requirements of ASTM A242.

### 3.09 PIPE SEPARATION

- A. Horizontal Separation-Water Mains and Sewers:
  1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary or sewer service connection.

2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:
  - a. Local conditions prevent a lateral separation of 3 m (10 feet); and
  - b. Water main invert is at least 450 mm (18 inches) above the crown of sewer; and
  - c. Water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with requirements listed in this Specification Section. Drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

1. A water main shall be separated from a sewer so that its invert is a minimum of 450 mm (18 inches) above the crown of drain or sewer whenever water mains cross storm sewers, sanitary sewers or sewer service connections. Vertical separation shall be maintained for that portion of the water main located within 10 feet horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
  - a. It is impossible to obtain the proper vertical separations described in (1) above; or
  - b. The water main passes under a sewer or drain.
3. A vertical separation of 450 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet).

3.010 SETTING OF VALVES AND BOXES

- A. Provide a surface concrete pad 450 by 450 by 150 mm (18 by 18 by 6 inches) to protect valve box when valve is not located below pavement.
- B. Clean valve and curb stops interior before installation.
- C. Set valve and curb stop box cover flush with finished grade.
- D. Valves shall be installed plumb and level and in accordance with manufacturer's recommendations.

3.011 SETTING OF FIRE HYDRANTS

- A. Set center of each hydrant not less than 600 mm (2 feet) nor more than 1800 mm (6 feet) back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 450 mm (18 inches) above finished grade. Set barrel flange not more than 50 mm (2 inches) above finished grade.

- B. Set each hydrant on a slab of stone or concrete not less than 100 mm (4 inches) thick and 375 mm (15 inches) square. Service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.
- C. Set bases in not less than 0.4 cubic meter (1/2 cubic yard) of crushed rock or gravel placed entirely below hydrant drainage device.
- D. Clean interiors of hydrants of foreign matter before installation.

3.012 PIPE SLEEVES

- A. Install where water lines pass through retaining walls, building foundations and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.013 FLUSHING AND DISINFECTING

- A. Flush and disinfect new water lines in accordance with AWWA C651.
- B. Initial flushing shall obtain a minimum velocity in the main of 0.75 m/sec (2.5 feet per second) at 40 PSI residual pressure in water main. Duration of the flushing shall be adequate to remove particles from the line.

Pipe Diameter		Flow Required to Produce 2.5 ft/sec(approx.) Velocity in Main		Number of Hydrant Outlets			
				Size of Tap. in. (mm)			
				1(25)	1 ½(38)	2(51)	2 1/2-in (64 mm)
In	(mm)	gpm	(L/sec)	Number of taps on pipe			
4	(100)	100	(6.3)	1	--	--	1
6	(150)	200	(12.6)	--	1	--	1
8	(200)	400	(25.2)	--	2	1	1
10	(250)	600	(37.9)	--	3	2	1
12	(300)	900	(56.8)	--	--	3	2
16	(400)	1,600	(100.9)	--	--	4	2

- 1. Backflow preventers shall not be in place during the flushing.
- C. Provide water source for filling, flushing, and disinfecting lines. Only potable water shall be used, and provide required temporary pumps, storage facilities required to complete specified flushing, and disinfection operations.
- D. Dispose of water used to flush and disinfect system in accordance with governing rules and regulations. Discharge water shall not be allowed to create a nuisance for activities occurring on or adjacent to the site.

- E. Bacteriological test specified in AWWA C651 shall be performed by a laboratory approved by the Health Department of the State. Cost of sampling, transportation, and testing shall be the responsibility of the Contractor.
- F. Re-disinfection and bacteriological testing of failed sections of the system shall be the sole responsibility of the Contractor.
- G. Before backflow preventers are installed, upstream piping shall be thoroughly flushed.

#### 3.014 HYDROSTATIC TESTING

- A. Hydrostatic testing of the system shall occur prior to disinfecting the system.
- B. After new system is installed, except for connections to existing system and building, backfill at least 300 mm (12 inches) above pipe barrel, leaving joints exposed. Depth of the backfill shall be adequate to prevent the horizontal and vertical movement of the pipe during testing.
- C. Prior to pressurizing the line, joint restraints shall be completely installed and inspected.
- D. If the system is tested in sections, and at the temporary caps at connections to the existing system and buildings, the Contractor shall provide and install required temporary thrust restraints required to safely conduct the test.
- E. Install corporation stops in the line as required to purge the air out of the system. At the completion of the test, corporation stops shall be capped.
- F. Perform pressure and leakage tests for the new system for 2 hours to 1375 kPa (200 psi). Leakage shall not exceed the following requirements.
  - 1. Copper Tubing: No leaks.
  - 2. Ductile Iron Pipe: AWWA C600. Provide to COR.
  - 3. Polyvinyl Chloride (PVC) AWWA C605. Provide to COR.

#### 3.015 BACKFLOW PREVENTOR TESTING

- A. Backflow preventers shall be tested and certified for proper operation prior to being placed in operation.
- B. Original copies of the certification shall be submitted to the COR.

---End of Section---

**SECTION 33 30 00  
SANITARY SEWERAGE UTILITIES**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Outside, underground sanitary sewer system, complete, ready for operation, including gravity flow lines, manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and other incidentals.

1.2 RELATED SECTIONS

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING. Dewatering: Section 31 23 19, DEWATERING.
- B. Concrete Work Reinforcing, Placement, and Finishing; Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- D. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 QUALITY ASSURANCE

- A. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and modifications to Public Utility Systems.

1.4 SUBMITTALS

Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

- A. Manufacturers' Literature and Data: Submit the following as one package:
  - 1. Pipe, Fittings, and, Appurtenances.
  - 2. Jointing Material.
  - 3. Manhole and Structure Material.
  - 4. Frames and Covers.
  - 5. Steps and Ladders.
  - 6. Gate Valves.
  - 7. Valve Boxes.
  - 8. Check Valves.
  - 9. Air Release Valves.
  - 10. Acid Neutralization Tanks.

## 1.5 REFERENCES

### A. American Society for Testing and Materials (ASTM):

1. A48/A48M-03 Gray Iron Castings
2. A615/A615M-06 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
3. A625/A625M-03 Tin Mill Products, Black Plate, Single Reduced
4. A746-03 Ductile Iron Gravity Sewer Pipe
5. C12-06 Installing Vitrified Clay Pipe Lines
6. C76-05b/C76M-05b Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
7. C139-05 Concrete Masonry Units for Construction of Catch Basins and Manholes
8. C150-05 Portland Cement
9. C425-04 Compression Joints for Vitrified Clay Pipe and Fittings
10. C478-06a/C478M-06a Precast Reinforced Concrete Manhole Sections
11. C700-05 Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
12. C828-03 Low-Pressure Air Test of Vitrified Clay Pipe Lines
13. C857-95(2001) Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
14. D698-00ae1 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))
15. D2321-05 Underground Installation of Thermoplastic Pipes for Sewers and Other Gravity-Flow Applications
16. D2412-02 Determination of External Loading Characteristics of Plastic Pipe by Parallel- Plate Loading
17. D2992-01 Practice for Obtaining Hydrostatic or Pressure Design Basis for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings
18. D3034-04a Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
19. D3212-96a (2003) e1 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
20. D4101-05a. Polypropylene Injection and Extrusion Materials
21. F477-02e1 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
22. F679-06 Poly (vinyl chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
23. F794-03 Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
24. F949-03 Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings

### B. American Water Works Association (AWWA):

1. C105/A21.5-05 Polyethylene Encasement for Ductile Iron Pipe Systems

2. C110/A21.10-03 Ductile-Iron and Gray-Iron Fittings for Water
  3. C111/A21.11-00 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
  4. C115-99 Flanged Ductile-Iron Pipe with Threaded Flanges
  5. C509-01 Resilient Seated Gate Valves for Water-Supply Service
  6. C515-01 Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service
  7. C550-05 Protective Epoxy Interior Coatings for Valves and Hydrants
  8. C600-05 Installation for Ductile-Iron Water Mains and Their Appurtenances
- C. American Association of State Highway and Transportation Officials (AASHTO):
1. M198-05 Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants
- D. Uni-Bell PVC Pipe Association:
1. Uni-B-6-98 Recommended Practice Low Pressure Air Testing of Installed Sewer Pipe

## PART 2 - PRODUCTS

### 2.1 PIPING

- A. Gravity Flow Lines (Pipe and Fittings):
1. Vitrified Clay: Pipe and fittings shall conform to ASTM C700, extra strength, with gasketed bell and spigot end joints. Joints on pipe and fitting shall conform to ASTM C425.
  2. Polyvinyl Chloride (PVC):
    - a. Pipe and Fittings, 100 to 375 mm (4 to 15 inches) in diameter: ASTM D3034, Type PSM, SDR 26, elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.
    - b. Pipe and fittings, 450 to 900 mm (18 to 36 inches) in diameter: solid wall, corrugated, or ribbed exterior profile, and a smooth interior.
      - 1) Corrugated Sewer Pipe: Conform to ASTM F949 corrugated sewer pipe with a smooth interior. Corrugated outer wall fused to smooth interwall at corrugation valley. Pipe and fitting with a smooth bell, elastomeric joints conforming to ASTM D3212, and minimum pipe stiffness of 350 kPa (50 psi) at 5 percent deflection, when tested in accordance with ASTM D2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without requirement for special fittings.
      - 2) Ribbed wall PVC pipe and fittings: Conform to ASTM F794 ribbed sewer pipe with smooth interior pipe and fittings with smooth bell, elastomeric joints conforming to ASTM D3212, and minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412, at 5 percent vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.

- 3) Solid wall pipe and fittings: Conform to ASTM F679, SDR 26, Pipe and fittings shall have gaskets conforming to ASTM F477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).
3. Ductile Iron Pipe (DIP) for Sanitary Sewer: Conform to ASTM A746, thickness Class 51 unless otherwise shown or specified. Joints on pipe and fittings shall be push-on style and conform to AWWA C110 and AWWA C111, rated for 1.03 MPa (150 psi). Exterior coating shall be approximately 0.025 mm (1 mil) asphaltic coating as specified in ASTM A746. Interior lining shall be a catalyzed coal tar epoxy, having a minimum thickness of 0.60 mm (24 mils), a permeability rating of 0.13 perms, direct impact rating of 11.3 Nm (100 in-lbs), an abrasion resistance of 20 liters of sand per mil, and dielectric strength of 250 volts per mil. Pipe and fittings shall be polyethylene encased with 0.20 mm (8 mil) polyethylene sheeting per AWWA C105. Color of polyethylene encasement shall be green.
- B. Gravity flow lines with secondary containment (pipe and fittings):
1. Fiberglass Piping and Fittings shall be manufactured in accordance with ASTM D2992 using a filament-winding process. Joints shall be adhesive bonded straight or tapered spigot and bells. Taper angles shall not be greater than 0.5 degrees. Pipe and fittings shall have an integral epoxy resin-rich reinforced liner not less than 0.50 mm (0.020 inch) for carrier pipes, and not less than 0.25 mm (0.010 inch) for containment pipe.
  2. Carrier pipe shall be installed with manufactured spacers to maintain a minimum interstitial space of 19 mm (0.75 inch) between the carrier pipe and the containment pipe.
  3. Piping shall be equipped with adequate monitoring ports to detect presence of fluids within the containment pipe and for the extraction of fluids from the containment pipe.

## 2.2 JOINTING MATERIAL

- A. Gravity Flow Lines:
1. Vitrified Clay Pipe: Rubber gasket, ASTM C425.
  2. Ductile Iron Pipe: Push-on or mechanical joints, AWWA C111, AWWA C110. Flange joints shall comply with AWWA C115. Flange joints shall only be used in vaults or above-grade.
  3. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.
  4. High Density Polyethylene (HDPE) pipe and fitting joints, ASTM E-3212, elastomeric gaskets, ASTM F477.
- B. Gravity Flow with Secondary Containment: Tapered or straight bell and spigot with adhesive bond. Completed joint shall be equal or greater than the pressure rating of the pipe.

## 2.3 MANHOLES AND VAULTS

- A. Manholes and vaults shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes and vaults shall be in accordance with the following:
1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal

- and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on Drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
  3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
  4. Flat top manhole tops shall be reinforced concrete as detailed on Drawings.
  5. Vaults: Reinforced concrete, as indicated on Plans, or precast reinforced concrete. Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C857.
  6. Mortar:
    - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
    - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21 L (5-1/2 gallons) per sack of cement.
  7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. Sealing compound shall be non-shrink and meet AASHTO M198.
  8. Frames and covers shall be gray cast iron conforming to ASTM A48. Frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "sanitary sewer". Studs and the lettering shall be raised 8 mm (5/16 inch). Cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. Bearing surface of the frame and cover shall be machine finished. Cover shall fit firmly on the frame without movement when subject to traffic.
  9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 406 mm (16 inches) wide and project a minimum of 178 mm (7 inches) away from the wall. Top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
  10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 10 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. Ladder assembly shall be rated for a minimum of 2200 N (500 pounds).

## 2.4 CONCRETE

- A. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. Cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Division 03 of these specifications.

2.5 REINFORCING STEEL

- A. Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.6 SEWAGE WET WELL (LARGER THAN 300 GALLONS WORKING VOLUME)

- A. Wet well shall be a precast vault conforming to ASTM C857. Vault shall have a precast bottom, walls, and top structure. Vault shall be constructed of 35 MPa (5000 psi) concrete at 28 days and ASTM A625, Grade 60 reinforcement. Vault shall be rated for HS20-44 loading and 30 percent impact loads.
- B. Joints in the precast structure shall be tongue and groove. Flexible sealing compound, conforming to AASHTO M198, shall be placed in joints to form a watertight structure.

2.7 CONCRETE PROTECTIVE COATING

- A. Concrete coating for the interior of wet wells shall consist of an epoxy blended filler sealer, and a cross linked epoxy phenolic cured, resistant protective coating.

2.8 ACID NEUTRALIZATION TANKS

- A. Acid neutralization tanks shall be constructed of 6 mm (1/4 inch) plate non code mild carbon steel suitable for rubber type lining with welds double butt, continuous full welded, non-porous and ground smooth and having no crevices, offsets or sharpened edges. Bottom and side walls shall be lined with 6 mm (1/4 inch) thermoplastic sheet lining fused directly to white ceramic lining 50 mm (2 inches) thick laid in Permamite acid and alkali proof mortar. Tank shall include 1050 mm (42 inch) ID manway riser constructed of steel shell with an interior corrosion resistant coating and complete cast iron frame and lid at finish grade. Neutralizing charge shall be limestone, 75 mm (3 inches) in size.

2.9 GATE VALVES

- A. AWWA C509, resilient seated gate valves rated for 1360 kPa (200 psi) WSP, reduced-wall resilient seated gates valves may be supplied in accordance with AWWA C515. Asbestos packing is prohibited. Interior and exterior of the valve shall be epoxy coated for AWWA C550.
- B. Operation:
  - 1. Shall turn counterclockwise to open.
  - 2. Underground: 50 mm (2 inch) nut for socket wrench operation.
  - 3. Above Ground and In Pits: Handwheels.
- C. Joints: End of valve shall accommodate, or be adapted to, pipe furnished.

2.10 VALVE BOXES

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness or metal shall be 5 mm (3/16 inch). Box shall be of such length as will be adapted, without full extension, to depth of cover required over pipe at valve location.
- B. Cast the word "SEWER" on the cover.
- C. Provide "T" handle socket wrenches, of 16 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box.

2.11 BACKWATER CHECK VALVES

- A. Backwater check valves shall be on offset-type, and have a cast iron body, bronze swing-check assembly, with bolted gasketed cover, and hub and spigot connections.

2.12 CLEANOUT FRAMES AND COVERS

- A. Frames and covers shall be gray iron casting conforming to ASTM C48. Frame and cover shall be rated for HS20-44 wheel loading, have a studded pattern on its cover, vent holes, and lifting slots. Cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word "SEWER" shall be cast on the cover.

2.13 WARNING TAPE

- A. Standard, 0.1mm (4Mil) polyethylene 76 mm (3 inch) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

**PART 3 - EXECUTION**

3.1 BUILDING SERVICE LINES

- A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line.
- B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the COR. The Contractor shall install temporary caps or plugs required for testing.
- C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of service lines. Mark the location and depth of the service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

3.2 ABANDONED MANHOLES STRUCTURES AND PIPING

- A. Manholes and Structures Outside of Building Areas: Remove frame and cover, cut and remove the top of an elevation of 600 mm (2 feet) below finished grade. Fill remaining portion with compacted gravel or crushed rock or concrete.
- B. Manholes and Structures with Building Areas: Remove frame and cover and remove entire structure and the base.
- C. Piping under and within 1500 mm (5 feet) of building areas shall be completely removed.
- D. Piping outside of building areas shall be completely removed.
- E. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

### 3.3 REGRADING

- A. Raise or lower existing manholes and structure frames and covers, cleanout frames and covers, and valve boxes in regraded areas to finish grade. Carefully remove, clean, and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on Drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, install a temporary cover above the bench of the structure or manhole. Temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering wastewater stream.

### 3.4 CONNECTIONS TO EXISTING VA OWNED MANHOLES

- A. During construction of new connections to existing manholes, maintain continued sanitary sewer service to buildings and users upstream. Provide and maintain pumping, conveyance system, dams, weirs, etc. required to maintain continuous flow of sewage. Temporary measures required to meet this requirement shall be subject to the review of the COR.
- B. Core existing structure, install pipe at design invert. Install an elastomeric gasket around pipe, and grout the interstitial space between the pipe and the core.
- C. Bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for pipes connected to the manhole.
- D. Connections and alterations to existing manholes shall be constructed so that finished work conforms as nearly as practicable to applicable requirements specified for new manholes, including concrete and masonry work, cutting and shaping.

### 3.5 PIPE SEPARATION

- A. Horizontal Separation - Water Mains and Sewers:
  - 1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
  - 2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
    - a. Local conditions prevent a lateral separation of ten feet; and
    - b. Water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
    - c. Water main is in a separate trench separated by undisturbed earth.
  - 3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. Pipe for the sanitary sewer main shall comply with specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER UTILITIES. Sewer shall be pressure tested as specified for pressure (force) mains before backfilling.
- B. Vertical Separation - Water Mains and Sewers at Crossings:
  - 1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 600 mm (24 inches) above the crown of gravity flow sewer or 1200 mm (48

inches) above the crown of pressure (force) mains. Vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.

2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.
3. When it is impossible to meet (1) above, gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. Pipe for the sewer shall conform to requirements for pressure sewers. Piping for the water main shall conform to Section 33 10 00, WATER UTILITIES.
4. Required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

### 3.6 GENERAL PIPING INSTALLATION

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the Work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. 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.
- E. Clean interior of 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.
- F. 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.
- G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 600 mm (2 feet) below water lines.
- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
  1. Ductile Iron Piping: AWWA C111 and C600.
  2. Vitrified Clay Piping: ASTM C12.
  3. Polyvinyl Chloride (PVC) Piping: ASTM D2321.

K. Gravity Flow Lines with Secondary Containment:

1. Install per manufacturer's recommendations. Install pipe centering devices to maintain an interstitial space below the invert of the carrier pipe. Both the carrier and containment pipe shall be tested for leaks.

3.7 MANHOLES AND VAULTS

A. General:

1. Circular Structures:

- a. Precast concrete segmental blocks shall lay true and plumb. Horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
- b. Precast reinforced concrete rings shall be installed true and plumb. Joints between rings and between rings and the base and top, shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
- c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:

- a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE.
  - b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
  4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
    - a. Forming directly in concrete base of structure.
    - b. Building up with brick and mortar.
  5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (1-inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.
  6. The wall that support access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
  7. Install steps and ladders per manufacturer's recommendations. Steps and ladders shall not move or flex when used. Loose steps and ladders shall be replaced by the Contractor.
  8. Install manhole frames and covers on a mortar bed, and flush with finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, rim elevation shall be 50 mm (2 inches) above the adjacent

finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

### 3.8 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES

- A. Reinforced concrete as detailed on Drawings. Concrete shall not restrict access for future maintenance of the joints within the piping system.

### 3.9 WET WELLS (PRECAST CONCRETE)

- A. Install the wet well on a 200 mm (8 inches) compacted aggregate base course.
- B. Set precast units level and plumb. Install sealant between precast.
- C. Core openings for pipe penetrations and seal with a modular seal. Seal shall be "link-seal" or approved equal.
- D. Grout joints and depressions in the vault. Install concrete protective coating per manufacturer's recommendations. Final coating shall be applied in two coats, providing a minimum thickness 0.15 - 0.20 mm (6-8 mils) dry film thickness per coat.
- E. Set top of wet well 300 mm (12 inches) above finish grade.
- F. Pipe and fittings entering and within the wet well shall be poly lined ductile iron pipe.
- G. Pipe penetrations through the walls of the wet well shall be sealed water tight.

### 3.10 DRY WELL AND VAULTS

- A. Install precast reinforced concrete vaults on a 200 mm (8 inches) compacted aggregate base course. Floor, walls, and top shall be level and plumb.
- B. Vaults shall be sized as indicated on Drawings. Orientate vault and internal piping, valves and appurtenances to provide access to valves and appurtenances for operation and maintenance of the equipment.
- C. Paint interior of dry well and vaults with two coats of alkyd enamel masonry paint.

### 3.11 ACID NEUTRALIZING TANKS

- A. Set tank on a 200 mm (8 inches) compacted sand base per manufacturer's recommendations.
- B. Inspect interior and exterior of the tank and repair damage to the lining. Place limestone in tank.
- C. Backfill around tank with sand material.

### 3.12 CLEANOUTS

- A. 150 millimeters (6 inches) in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, in a 300 by 300 by 150 mm (12 by 12 by 6 inches) thick concrete slab set flush with adjacent finished grade. Where cleanout is in force main, provide a blind flange top connection. Center of the flange shall be equipped with a 50 mm (2 inches) base valve to allow

the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 600 mm (24 inches) in diameter.

- B. Top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

### 3.13 SETTING OF GATE VALVES

- A. Avoid setting valves under pavement except where shown on Drawings.
- B. Clean valve interior before installation.
- C. Set valve plumb, restrain ends of valves when indicated on Drawing.
- D. Set valve box cover flush with finished grade. Valve box shall be centered over the operating nut.

### 3.14 INSPECTION OF SEWERS

- A. Inspect and obtain the COR's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

### 3.15 TESTING OF SANITARY SEWERS

- A. Gravity Sewers and Manholes (Select one of the following):
  1. Air Test: Vitrified Clay Pipe ASTM C828. PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-pressure of any groundwater above the sewer. Minimum test time shall be as specified in Uni-Bell Uni-B-6.
  2. Exfiltration Test:
    - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11 L (3.0 gallons) per hour per 30 m (100 feet).
    - b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.
  3. Infiltration Test: If ground water level is greater than 900 mm (3 feet) above invert of the upper manhole, infiltration tests are acceptable. Allowable leakage for this test will be the same as for the exfiltration test.
- B. Testing of Concrete Wet Well: No leakage with the wet well completely filled with water for a duration of 4 hours.

---End of Section---

**Section 33 40 00  
STORM DRAINAGE UTILITIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Materials and procedures for construction of outside, underground storm sewer systems.

**1.2 RELATED SECTIONS**

- A. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: section 31 20 00, EARTH MOVING.
- B. Concrete work, reinforcing, placement and finishing: section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Fabrication of steel ladders: section 05 50 00, METAL FABRICATIONS.
- D. Materials and testing report submittals: section 01 33 23, shop drawings, PRODUCT DATA AND SAMPLES.
- E. Erosion and sediment control: section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

**1.3 DEFINITIONS**

- A. HDPE: High-density polyethylene
- B. PE: Polyethylene

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle catch basins according to manufacturer's written rigging instructions.

**1.5 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.

**1.6 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - B745/B745M-97(2005)..... Corrugated Aluminum Pipe for Sewers and Drains
  - C14-07..... Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe
  - C478-09 ..... Precast Reinforced Concrete Manhole Sections
  - C923-08 ..... Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
  - C924-02(2009) ..... Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

- C1103-03(2009) ..... Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- C1173-08 ..... Flexible Transition Couplings for Underground Piping Systems
- D2321-11 ..... Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D3034-08 ..... Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- D3350-10 ..... Polyethylene Plastics Pipe and Fittings 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
- F714-10 ..... Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- F1417-11 ..... Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- F1668-08 ..... Construction Procedures for Buried Plastic Pipe
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - M252-09 ..... Corrugated Polyethylene Drainage Pipe
  - M294-10 ..... Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500 mm) Diameter
- C. American Concrete Institute (ACI)
  - 350/350M-06 ..... Environmental Engineering Concrete Structures and Commentary

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Standardization of components shall be maximized to reduce spare part requirements. Guarantee performance of assemblies of components, and repair or replace assembly elements.

### **2.2 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 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 manufacturer.

C. PVC Type PSM Sewer Piping

1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

**2.3 NONPRESSURE TRANSITION COUPLINGS**

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials
  1. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
  2. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

**2.4 CATCH BASINS**

- A. Standard Precast Concrete Catch Basins:
  1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
  2. Concrete: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
  3. Size: As noted on Plans.
  4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section.
  5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
  6. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. Sealing compound shall be non-shrink and meet AASHTO M-198B.

7. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into walls, for each pipe connection.
8. Frame and Cover for Gratings:
  - a. Galvanized steel: conforming to ASTM A123.
  - b. Cast iron: conforming to ASTM A48
  - c. Weight, shape, size, and waterway openings for grates shall be as indicated on Drawings.

## **2.5 AREA DRAINS**

- A. Area Drains:
  1. 6" diameter structurally foamed polyolefin or high density polyethylene round, flat grate with U.V. inhibitors. Color of drain shall be black. Directly connect to 6-inch riser pipe and tee connection with storm drain lateral. Open surface area shall be at least 9 square inches. Maximum flow rating shall be at least 10 gallons per minute.

## **2.6 SLOT DRAINS**

- A. General requirements: Modular system of slot drains and appurtenances; designed so slot drains fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.
- B. Slot Drain:
  1. 11-gage galvanized steel with 7/16- inch nominal width vertical opening and an overall nominal base width of 4.84- inch. Slot drain shall be secured on polymer concrete channel drain with a boltless locking system, yet be able to be removed for channel drain maintenance.
  2. Install per manufacturer's recommendations.

## **2.7 CLEANOUTS**

- A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
  1. Top-Loading Classification(s): Light Duty
  2. Pipe fitting and riser to cleanout shall be same material as main pipe line.
- B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

## **2.8 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**

#### **3.1 PIPE BEDDING**

- A. Bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. When necessary, 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 requirements of ASTM D2321. Bedding, haunching, and initial backfill shall be either Class IB or Class II material.

#### **3.2 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 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 manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. 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. Install PVC sewer piping according to ASTM D2321 and ASTM F1668.

### **3.3 CONNECTIONS TO EXISTING VA-OWNED MANHOLES**

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

### **3.4 CATCH BASIN INSTALLATION**

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

### **3.5 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.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. Unshielded flexible couplings for same or minor difference OD pipes.
    - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
  - 2. Use pressure-type pipe couplings for force-main joints.

### **3.6 IDENTIFICATION**

- A. Install green warning tape directly over piping and at outside edge of underground structures.

### **3.7 FIELD QUALITY CONTROL**

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred.
  - 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.

### **3.8 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, 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. 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.

### **3.9 CLEANING**

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

---End of Section---

**SECTION 33 46 13  
SUBDRAINAGE**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Subdrainage system adjacent to walls, and connection to storm sewer.

**1.2 SUBMITTALS**

- A. Product data for the following:
  - 1. Perforated pipe and fittings.
  - 2. Solid pipe and fittings.
  - 3. Geotextile fabrics.
- B. Samples:
  - 1. Drainage Fill.
- C. Product Data: Certifications from manufacturers attesting that materials meet Specification requirements.

**1.3 REFERENCES**

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - 1. M252 Corrugated Polyethylene Drainage Tubing
- B. American Society for Testing and Materials (ASTM):
  - 1. D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
- C. Caltrans Standard Specifications:
  - 1. Section 68 Subsurface Drains
  - 2. Section 88 Engineering Fabrics

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe-fittings, and seals from dirt and damage.
- C. Protect permeable material from contamination by other materials.

**PART 2 - PRODUCTS**

**2.1 PERFORATED WALL AND SOLID WALL PIPE**

- A. PE Pipe and Fittings (HDPE): 4-inch through 10-inch, AASHTO M252 Type S (Solid wall.) or SP (Perforated wall.), smooth interior and corrugated exterior. Bell and spigot joints.
  - 1. Bell and Spigot Joint Gasket: Elastomeric seal, ASTM F 477.

2. Couplings: AASHTO M 252, corrugated band type. Engage a minimum of 4 corrugations, 2 on each side of pipe joint.

3. Perforation Size, Location, and Spacing: AASHTO M 252, Class 2.

B. PVC Pipe and Fittings:

1. Pipe: 4-inch through 15-inch, ASTM D 3034, SDR 35. Bell and spigot joints.

2. Perforation Size, Location, and Spacing: ASTM D 2729.

3. Fittings: ASTM F 1336.

4. Joint Gasket: Elastomeric seal, ASTM F 477.

**2.2 SPECIAL PIPE COUPLINGS**

A. Description: ASTM C 1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.

**2.3 DRAINAGE FILL MATERIAL**

A. Caltrans Permeable Material: Class 2 conforming to Section 68-1.025 of Caltrans Standard Specifications, Class 2.

**2.4 GEOTEXTILE FILTER FABRIC**

A. Where indicated on plans, use nonwoven geotextile filter fabric for encasing permeable drainage material.

1. Caltrans Filter Fabric: Section 88-1.02B of Caltrans Standard Specifications.

2. ASTM D6707.

B. Geotextile shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters.

C. Survivability shall be Class 3.

D. Apparent opening size shall be No. 70.

E. Permittivity shall be 0.5 per second, minimum.

**2.5 IMPERMEABLE GEOMEMBRANE LINER**

- A. Where indicated on plans, use impermeable geomembrane for lining turf subdrainage materials.

Property	Thickness 30 mil	Test Method
Thickness, % Tolerance	±5	ASTM D 5199
Tensile Strength, lbs/in width	73	ASTM D 882, Method B
Modulus at 100% Elongation, lbs/in	30	ASTM D 882, Method B
Ultimate Elongation, %	380	ASTM D 882, Method A
Tear Resistance, lbs	8	ASTM D 1004
Low Temperature Impact, degrees F	-20	ASTM D 1790
Volatile loss, % max.	0.7	ASTM D 1203, Method A
Pinholes, No. per 10 sq. yds. max.	1	N/A
Bonded Seam Strength, % of tensile strength	80	N/A

**2.6 FILTER FABRIC**

- A. When required, use filter fabric for encasing permeable material around subdrains.
1. Caltrans Filter Fabric: Section 88-1.02B of Caltrans Standard Specifications.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. Install only after unsatisfactory conditions have been corrected.

**3.2 PIPING APPLICATIONS**

- A. Refer to Plans for location, size, and material designation for individual subdrains.

**3.3 INSTALLATION OF PERFORATED PORTIONS OF SUBDRAINS**

- A. Excavation: Section 6 of ASTM D 2321 and as indicated.
- B. Subdrain Bedding: Place supporting layer of drainage fill over compacted subgrade to compacted depth indicated. If drainage fill requires encasement in filter fabric, lay filter fabric in trench and overlap trench sides before installing drainage fill.
- C. Piping Installation: Install pipe in accordance with Section 7 of ASTM D 2321. Install piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert. Excavate recesses for bottoms of bell ends of pipe. Lay pipe with bells facing upslope and with spigot end centered fully into adjacent bell. Bed piping with full pipe bearing in drainage fill material. Lay perforated pipe with perforations down. Install gaskets, seals, sleeves, and couplings in accordance with manufacturers written instructions. Use increasers, reducers, and couplings made for different sizes of materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- D. Initial Subdrain Backfill: After installing drainage piping, add drainage fill up to top of pipe to perform tests.

- E. Testing Subdrain: After installing drainage fill to top of pipe, test drain piping with water to ensure free flow before backfilling with drainage fill. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
- F. Subsequent Subdrain Backfill: After satisfactory testing, cover piping with drainage fill to width and height indicated. Place drainage fill in layers not exceeding 3 inches in loose depth; compact each layer placed. If filter fabric is required complete the filter fabric encasement by bringing fabric to top and closing the encasement.
- G. Fill to Grade: Place native fill material over compacted drainage fill to thickness indicated. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish elevations unless otherwise specified on the Plans.

### **3.4 INSTALLATION OF NON-PERFORATED PORTIONS OF SUBDRAINS**

- A. Conform to Section 33 40 00 - Storm Drainage Utilities.

### **3.5 JOINING PIPE**

- A. Join PVC pipe and fittings with elastomeric seals according to ASTM D 2321.
- B. Special pipe couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and that fit both pipe materials and dimensions.

### **3.6 CLEANING**

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

---End of Section---