SITE INFRASTRUCTURE
TECHNICAL SPECIFICATIONS

for

DRY CREEK RANCHERIA
BAND OF POMO INDIANS

CONFIDENTIAL – NOT TO BE DISCLOSED

June 2, 2008
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SUPPLEMENTAL GENERAL REQUIREMENTS FOR SITE INFRASTRUCTURE

PART 1  GENERAL

1.1  DEFINITION OF TERMS:  Whenever in this portion of the contract documents, consisting of the Plans, Technical Specifications, Supplemental Conditions, or in any other documents or instruments where these conditions govern, the following terms or pronouns are used, the intent and meaning shall be interpreted as follows:

A.  AGENCY OF JURISDICTION – The Dry Creek Gaming Commission (DCGC) is the governmental entity having jurisdiction over the work being performed. Wherever the designation “City”, “City Engineer”, “Chief Building Official”, or “County” is used in the Contract Documents, it shall be taken to mean DCGC, including its duly authorized representatives, acting within the scope of the duties entrusted to them.

B.  AS INDICATED – As shown or indicated on the Plans or other Contract Documents.

C.  CONSULTING ENGINEER OR ENGINEER - The Engineering firm of record retained by the Owner or the Design-Build Contractor, including its duly authorized representatives, acting within the scope of the duties entrusted to them.

D.  CONTRACT – The written Agreement, in the prescribed form, covering the performance of the work and the furnishing of labor and materials in the construction of the Project, including all documentation called for therein.

E.  CONTRACT DOCUMENTS – The complete contract which includes the following documentation is collectively referred to as the "Contract Documents." The Contract Documents include, but are not limited to, the accepted Proposal, the General Conditions, Supplementary Provisions (if any), the General Requirements, any Supplemental Requirements, these Site Infrastructure Technical Specifications, the complete Plans, Profiles and Details, any Addenda, and any duly authorized change orders.

F.  CONTRACTOR – The person, or persons, co-partnership, or corporation who have been awarded the contract and who have entered into a contract with the Owner to perform the work provided for in the Contract Documents. The word "Contractor," although used herein as terming an individual, shall be taken to mean the Contractor, his agents, employees and officials.
G. GEOTECHNICAL CONSULTANT (SOILS ENGINEER) - The firm of Consulting Geotechnical Engineers retained by the Owner, including its duly authorized representatives, acting within the scope of the duties entrusted to them.

H. GEOTECHNICAL REPORT(S) – Report(s) prepared by a licensed Geotechnical Consultant addressing geotechnical issues related to the Project.

I. LANDSCAPE ARCHITECT - The Landscape Architectural firm retained by the Owner, including its duly authorized representatives, acting within the scope of the duties entrusted to them.

J. NOTICE TO PROCEED - The Notice by which Owner directs the successful bidder as Contractor to proceed with the Project.

K. OWNER – Dry Creek Rancheria Band of Pomo Indians.

L. OWNER’S REPRESENTATIVE - The Owner's official designated to administer the terms of the contract for the Project and to exercise the authority and perform the duties vested in the Owner by the express and implied provisions of the Contract Documents. The Owner’s Representative is the Director of Project Development, including his duly authorized representatives, acting within the scope of duties entrusted to them. The Owner may retain or employ Construction Managers, Program Managers, Design Managers, etc. to assist the Director of Project Development carry out the duties of Owner’s Representative within the scope assigned by the Director of Project Development.

M. PLANS/PROJECT PLANS/IMPROVEMENT PLANS - The official plans, profiles, typical cross sections, general cross sections, working drawings, detail drawings and supplementary drawings, or exact reproductions thereof, prepared by the Consulting Engineer and approved by the Owner and DCGC, which show the location, character, dimensions, and details of the work to be done, and which are to be considered as part of the contract, supplementary to the Specifications.

N. PROJECT - All of the work called for in the Contract as specified herein, or shown, noted or called for in the Specifications or on the Plans including all work incidental thereto.

O. SPECIFICATIONS - The directions, provisions, and requirements contained in these General Conditions, Site Infrastructure Technical Specifications, and any Supplemental Provisions as may be necessary, pertaining to either the materials and/or the work to be furnished under the Contract.
1.2 STANDARD SPECIFICATIONS

A. Whenever in these documents reference is made to the provisions or requirements of the "Standard Specification, State Standard Specifications or Caltrans Standard Specifications," the reference shall be understood to refer to the State of California, Department of Transportation, Standard Specifications and all subsequent amendments, the issue in effect at the time of preparation of the Plans and these Specifications.

B. Reference to the Standard Specifications shall be for purposes of information on technical, material, product, equipment, or installation requirements. Standard Specification, General Provision, Sections 1, 2, 3, 4 (Except 4-1.02 and 4-1.04), 5 and 9 shall not be applicable to this project. In addition, all references in the remaining Sections to measurement and/or payment shall not be applicable to the Project.

C. Where the term “Engineer,” “Director,” or “State” is used in the Standard Specifications it shall mean the Owner or the Owner’s Representative.

1.3 STANDARD PLANS

A. Whenever in these documents reference is made to the "Standard Plans," "State Standard Plans" or "Caltrans Standard Plans" the reference shall be understood to refer to the Standard Plans, State of California, Department of Transportation, and all subsequent errata for the issue in effect at the time of preparation of the Plans and these Specifications.

1.4 PROJECT REPORTS

A. Bidder is responsible to obtain all relevant project reports and reference material available from the Owner and review adequately to prepare an informed bid. The project reference material may include some or all of the following reports as well as reports on other relevant subjects:
   1. Geotechnical Report
   2. Hazardous Waste Investigation
   3. Arborist’s Report
   4. Biological Assessment

PART 2 CONTROL OF THE WORK

2.1 INTERPRETATION OF PLANS AND SPECIFICATIONS

A. The Plans, General Conditions, Site Infrastructure Technical Specifications, and any Supplemental Provisions are essential parts of the Contract for the Project, and
requirements occurring in one are as binding as though occurring in all. They are intended to be cooperative, to describe and provide for a complete project.

B. Should it appear to the Contractor that the work to be done, or any of the matters relative thereto, is not sufficiently detailed or explained on the Plans, in the General Conditions, Site Infrastructure Technical Specifications, or any Supplemental Provisions, he shall proceed in accordance with Section 01320.

C. In the event of any discrepancy between any drawing and the figures written thereon, the figures shall be taken as correct. Detail drawings shall prevail over general drawings.

D. The hierarchy of interpretation of the Contract Documents is as follows, with each document governing over all documents listed below it:
   1. Special Provisions (governs over all other documents)
   2. Project Plans
   3. These Site Infrastructure Technical Specifications
   4. Standard Plans

2.2 STANDARDS TO APPLY IN LIEU OF SPECIFICATIONS

A. Wherever in these Contract Documents, or in any orders that may be given by the Owner pursuant to or supplementing these documents, it is required that the Contractor shall furnish materials or manufactured articles for which no detailed specifications are set forth, the materials or manufactured articles shall be of the best grade in quality and workmanship obtainable in the market from companies of established reputation; or if not ordinarily carried in stock, shall conform to the accepted standards for first class materials or articles of the kind required, with due consideration for the use to which they are to be put. All work, for which no detailed specifications are set forth herein, shall conform to accepted standards for first class work of the kind required.

B. Materials and equipment shall be new and of recent manufacture and shall be the producer's standard kinds regularly produced for the quality series required, except for special features shown or specified, which shall conform to the described special requirements. Reclaimed or used materials shall not be used unless particularly provided for under these Contract Documents.

C. The Project shall include the provision of all materials, equipment and apparatus not specifically mentioned herein or noted on the plans, but which are obviously necessary to complete the work specified.
2.3 REFERENCED STANDARDS

A. Material specified by reference to number, symbol, or title of a specific standard (such as Commercial Standard, Federal Specification, trade association standard, or other standard) shall comply with requirements in latest revision thereof, including amendments or supplements thereto in effect on issue date of these Specifications.

2.4 RULES AND REGULATIONS

A. All work done and materials and equipment transported, handled, stored or installed shall be done in strict conformance with the applicable orders, rules and regulations of the State of California, Division of Industrial Safety, and DCGC requirements. Nothing contained in these specifications or shown or noted on the plans shall be construed to permit work not conforming to these orders, rules, and regulations.

B. When plans or specifications call for material or construction of a better quality or larger size than may be required by applicable codes or standards, the provisions of the plans and/or specifications shall take precedence over the requirements of the code or standard. If there is any other conflict between the plans or specifications and the requirements of applicable codes and standards, the provisions of the code or standard shall govern.

PART 3 CONTRACTOR’S OPERATION

3.1 JOB SITE SAFETY

A. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal work hours. Any construction review of the Contractor's performance conducted by the Geotechnical Consultant, the Consulting Engineer, the Landscape Architect, or any other consultant to the Owner (or the representatives, agents, or employees of same) is not intended to include review of the adequacy of the Contractor's safety measures in, or near the construction site.

3.2 EXISTING FACILITIES

A. Attention is specifically called to the existence of critical utilities and facilities in place along the line of work. The Contractor will be solely and completely responsible for the protection and preservation of such utilities, facilities and appurtenances as exist on the site, and for the exact location of same. Locations of existing utilities, facilities and appurtenances, insofar as they are known from
information available, have been shown on the Plans. DCGC, Owner, Geotechnical Consultant, Consulting Engineer, or Landscape Architect assumes no responsibility for the accuracy or completeness of said data, which is offered solely for the convenience of the Contractor. It shall be the Contractor's responsibility to verify the location of these facilities and to locate any other underground utilities and structures which might necessitate a change in the location, line or grade of the new work. It shall be the Contractors sole responsibility to coordinate with the utility providers and, if their utilities or facilities are damaged by the Contractor, the Contractor shall make necessary repairs at his own cost.

3.3 UTILITY COORDINATION

A. All relocations of apparent or discovered public utility lines (e.g., power, telephone, gas, cable TV, etc.) shall be accomplished by the forces of the appropriate utility providers. The Contractor shall notify the Owner or appropriate utility companies at least 72-hours prior to the start of construction and shall effect the necessary coordination to have these structures or lines removed, relocated and/or adjusted.

B. Existing utilities are shown on the plans for general information only. The locations shown are approximate only and are based upon record data. The Contractor shall assume full responsibility for locating all existing utilities prior to start of any construction activity (e.g., excavation, clearing, grubbing, and trenching) which may damage any existing utilities. Furthermore, the Contractor shall protect all existing or newly installed utility structures and lines from damage by his forces during the construction period (from the Notice to Proceed until final acceptance).

C. The Owner and DCGC shall not be responsible for any damage to Contractor because of delays or restrictions that may be caused by the work of other agencies, or the requirements thereof.

D. Efforts have been made to locate and identify known utilities that have to be protected during construction. However, if upon excavation, a known utility service is deemed to be in conflict with the new work, the Contractor shall so notify the Owner’s Representative who shall determine the action to be taken. Note all changes on record drawings.

E. If an unknown utility that is not in conflict with the new work is discovered during excavation, it shall be protected and work will progress around the utility without causing an unnecessary delay. Note location, horizontal and vertical, of discovered utility on record drawings.

END OF SECTION
PART 1   GENERAL

1.1 SECTION INCLUDES

A. Demolition and removal of above and below grade portions of existing buildings designated.

B. Hazardous waste removal.

C. Disconnection, capping or sealing of utilities in slab portions to remain and removal or abandonment of utilities in other portions of the buildings designated.

D. Cleanup and disposal of demolished or removed materials.

1.2 SECTION EXCLUDES

A. Demolition or removal of existing site work, including underground utilities and appurtenances. See Section 02230.

1.3 RELATED SECTIONS

A. Section 02230, Tree Removal, Site Clearing, Stripping, and Grubbing.

B. Section 02300, Earthwork.

1.4 RELATED DOCUMENTS

A. Geotechnical Report.


C. ANSI:
   1. 10.6-1990: Safety Requirements for Construction and Demolition.

D. 40 CFR:
   1. 82: Protection of Stratospheric Ozone.

E. NFPA:
1.5 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless they indicated to be removed and salvaged or recycled.

B. Remove and Salvage: Detach items from existing construction, prior to demolition, and deliver them to the Owner’s Representative.

C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or recycled.


F. EPA: Environmental Protection Agency.


1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 02000.

B. Submit qualification data for demolition firm.

C. Submit qualification data for professional engineer.

D. Submit qualification data for refrigerant recovery technician. Technician must be certified by EPA approved certification program.

E. Submit statement of refrigerant recovery, signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Schedule of Building Demolition Activities: Prepare and submit, to the Owner’s Representative, a schedule indicating the following:
   1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
   2. Shut-off of utilities.
   3. Installation of temporary facilities to protect other facilities on the site as well as facilities on adjacent properties.
   4. Location of temporary protection and means of egress.
5. Coordinate Owner’s continuing occupancy of adjacent buildings and partial use of premises.

G. Prior to demolition submit, to the Owner’s Representative, photographs or a video tape showing existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by building demolition operations.

H. Submit to the Owner’s Representative a receipt showing acceptance of hazardous waste by a landfill licensed to accept hazardous waste.

I. After building demolition is complete, submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

A. Building demolition and removal to meet with the approval of the Owner’s Representative and other municipal agencies having jurisdiction.

B. Backfill density testing to be performed in accordance with Section 02300.

C. Demolition firm to be an experienced firm that has specialized in demolition work similar in material and extent to that indicated for this project.

D. Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

E. Comply with the following standards:
   1. ANSI A10.6.
   2. NFPA 241.

F. Conduct a conference at the Project site to review methods and procedures related to building demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be demolished.
   2. Review structural load limitations of the existing structure.
   3. Review and finalize the building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review and finalize protection requirements.

1.8 PROJECT CONDITIONS
A. The Owner’s Representative will be responsible for vacating the occupants of the
building(s) to be demolished prior to demolition work by the Contractor.

B. The Owner assumes no responsibility for the physical condition of the building(s) to
be demolished. The conditions existing at the time of inspection for bidding purposes
will be maintained by the Owner’s Representative as far as practical.

C. Before building demolition, the Owner will remove the items as noted on the Plans
and in the Special Provisions.

D. Hazardous Materials:
   1. Hazardous materials that have been identified in the building to be demolished are
   2. Although other hazardous materials are not expected, a detailed survey for other
hazardous materials has not been performed. If other materials suspected of
containing hazardous materials are encountered, the Contractor shall leave them
undisturbed and immediately notify the Owner’s Representative for direction.

E. Do not disable or disrupt building fire or life safety systems without 3-day prior
written notice to the Owner’s Representative and other agencies having jurisdiction.

F. Obtain all required permits from authorities related to the demolition.

G. Confine demolition work to the work hours established by Owner’s Representative
for this project.

H. Provide temporary facilities to protect other improvements on the site, as well as
improvements on adjacent properties, from damage due to demolition work. Obtain
written approval of these facilities, and any equipment encroachment, from each
property owner.

I. Maintain entrances and exits to the site occupied by the building, as well as those to
adjacent properties, or provide alternate routes approved by each property owner,
unless otherwise authorized by each property owner.

J. Do not use explosives for demolition without written permission from the Owner.

1.9 COORDINATION

A. Arrange demolition schedule so as not to interfere with other activities on the parcel
or adjacent parcels by other tenants.

PART 2 PRODUCTS
2.1 SOIL MATERIALS

A. Backfill excavations resulting from demolition operations with on-site or import materials conforming to structural backfill defined in Section 02300.

PART 3 EXECUTION

3.1 EXAMINATION

A. Survey existing conditions and correlate them with requirements indicated to determine the extent of building demolition required.

B. Investigate unanticipated mechanical, electrical, or structural elements, if encountered, and measure the nature and extent of the elements and promptly submit a written report to the Owner’s Representative.

C. Provide a professional engineer or other competent person to perform an engineering survey of the conditions of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during building demolition operations. A competent person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to the Contractor’s employees and who has authorization from the Contractor to take prompt corrective measures to eliminate them.

D. Inventory and record the condition of items to be removed and salvaged

E. Verify that hazardous materials have been remediated before proceeding with building demolition.

3.2 PREPARATION

A. Refrigerant: Remove and store refrigerant according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Remove or remediate known hazardous materials prior to demolition operations.

C. Locate, identify, disconnect and seal or remove utilities serving the building to be demolished.
   1. Arrange shut off of utilities with the Owner or appropriate utility company.
   2. If utility services are required to be removed, relocated, or abandoned, before proceeding with building demolition, provide temporary utilities that bypass
buildings or structures to be demolished and that maintain continuity of service to other buildings and structures.

D. Provide and maintain temporary interior and exterior shoring, bracing or structural support to preserve stability and prevent unexpected movement or collapse of the building being demolished. Strengthen or add new supports when required during progress of demolition.

E. Remove refrigerant from air-conditioning equipment before starting demolition.

3.3 PROTECTION

A. Protect adjacent facilities that are to remain, such as walkways, parking areas, landscaping, buildings, etc. Protect portions of the building that are to remain.

B. Maintain and protect existing utility services indicated to remain during demolition operations.
   1. Do not interrupt existing utilities serving other portions of the parcel and adjacent occupied facilities unless authorized by each property owner.
   2. If interruption of existing utilities serving other portions of the parcel or other adjacent facilities is necessary, provide temporary services as is acceptable to each property owner. Provide at least 72-hours notice to the individual property owner if shutdown is required for any reason.

C. Erect temporary protection such as walks, fences, railings, canopies, and covered passageways where required to protect workmen and the public, including but not limited to the following:
   1. Protect existing site improvements, appurtenances, and landscaping to remain.
   2. Provide temporary barricades and other protection required to prevent Injury to people and damage to adjacent buildings and facilities to remain.
   3. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
   4. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.

3.4 DEMOLITION, GENERAL

A. General: Demolish indicated existing building(s) except those portions designated to remain. Use methods required to complete the Project within limitations of governing regulations and as follows:
   1. Do not use cutting torches until work area is cleared of flammable materials.
   3. Maintain adequate ventilation when using cutting torches.
3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Engineering Surveys: Perform surveys as the Project progresses to detect hazards that may result from building demolition activities. Cease operations immediately if structure appears to be in danger. Notify the Owner’s Representative immediately and do not resume operations until authorized by the Owner’s Representative.

C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from the Owner’s Representative and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
   2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent facilities or create hazardous or objectionable conditions, such as flooding and pollution.

3.5 MECHANICAL DEMOLITION

A. Remove building segments intact when permitted by authorities having jurisdiction.

B. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

C. Remove debris from elevated portions by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

D. Remove structural framing members and lower to ground by method suitable to minimize ground impact or dust generation.

E. Concrete and Masonry: Cut concrete full depth a junctures with construction indicated to remain, using power driven saw, then remove material between saw cuts.

F. Concrete Slabs-on-Grade: Saw-cut area to be demolished at junctures with construction indicated to remain, then break up and remove.

G. Building Components to be Recycled or Salvaged: Remove items to be salvaged as whole units, intact and undamaged. Items to be recycled or salvaged are as noted on the Plans or in the Special Provisions.
H. Equipment to be Recycled or Salvaged: Disconnect equipment at nearest fitting connection to services, complete with service valves. Remove as whole units, complete with controls.

I. Below-Grade Construction: Except where specified to remain, demolish and remove foundations, slabs and other below grade constriction to at least 36” below the existing grade.

J. Existing Utilities:
   1. Pipes or conduits discontinued from service that are more than 36-inches below the existing grade and are more than 5-feet outside the footprint of the new construction, may be abandoned in place. Securely close ends of abandoned piping with tight fitting plug or wall of concrete minimum 6-inches thick.
   2. Pipes or conduits discontinued from service that are 36-inches or less below the existing grade and within the footprint, and 5-feet beyond, the new construction, shall be removed completely, including valves, cleanouts, water meters, etc.

3.6 EXPLOSIVE DEMOLITION

A. Explosives: Use of explosives is not permitted without written permission from the Owner.

3.7 SITE RESTORATION

A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with structural fill/backfill in accordance with Section 02300.

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

A. General: Promptly repair damage to adjacent construction caused by building demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
3.9  RECYCLING DEMOLISHED MATERIALS

A. Comply with the recycling requirements of agencies having jurisdiction.

B. Fluorescent lamps and fixtures contain hazardous materials and shall be appropriately recycled.

C. General: Separate recyclable demolished materials from other demolished materials to the maximum extent possible. Separate recyclable materials by type.
   1. Provide containers or other storage method approved by the Owner’s Representative for controlling recyclable materials until they are removed from the Project site.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Store components off the ground and protect from the weather.
   4. Transport recyclable materials off of the Owner’s property and legally dispose of them unless they are to be recycled within the project boundaries.

D. Asphalt: Grind asphalt to maximum 4-inch size.

3.10 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, or otherwise indicated to remain the Owner’s property, remove demolished materials from project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

3.11 CLEANING

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

END OF SECTION
SECTION 02230

TREE REMOVAL, SITE CLEARING, STRIPPING, AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Protecting existing trees and vegetation to remain.
B. Trimming tree limbs and roots.
C. Removing trees as designated.
D. Clearing vegetation, debris, trash and other materials within limits indicated.
E. Grubbing of vegetation within limits indicated.
F. Stripping of topsoil within limits indicated.
G. Removing above-grade site improvements within limits indicated.
H. Disconnecting, capping or sealing, and abandoning site utilities in place.
I. Disconnecting, capping or sealing, and removing site utilities.
J. Disposing of objectionable material.

1.2 RELATED SECTIONS

A. Section 02300, Earthwork.
B. Section 02221, Building Demolition.

1.3 RELATED DOCUMENTS

A. Arborist’s report, if available.
B. Geotechnical Report.
C. Caltrans Standard Specifications.
   1. Section 16, Clearing and Grubbing.
D. Applicable Publications
2. “Arboriculture,” the care of trees and shrubs by Dr. Richard Harris.

1.4 DEFINITIONS


B. CAL-OSHA: California Occupational Safety and Health Administration.

C. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2-inches in diameter; and free of weeds, roots, and other deleterious materials.

1.5 SUBMITTALS

A. Follow Submittal procedure outlined in Section 01330.

B. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

1.6 QUALITY ASSURANCE

A. Do not remove or prune trees without first securing a permit from the appropriate agency.

B. Prune to the standards of the International Society of Arborists and to ANSI 300.

1.7 PROJECT CONDITIONS

A. Except for materials indicated to be stockpiled or to remain the Owner’s property, cleared materials are the Contractor's property. Remove cleared materials from site and dispose of in lawful manner.

B. Salvage.Improvements: Carefully remove items indicated to be salvaged and store where indicated on plans or where designated by the Owner’s Representative. Avoid damaging materials designated for salvage.
C. Unidentified Materials;
   1. If unidentified materials are discovered, including hazardous materials that will
      require additional removal other than is required by the Contract Documents,
      immediately report the discovery to the Owner’s Representative.
   2. If necessary, the Owner’s Representative will arrange for any testing or analysis
      of the discovered materials and will provide instructions regarding the removal
      and disposal of the unidentified materials.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

   A. Backfill excavations resulting from demolition operations with on-site or import
      materials conforming to structural backfill defined in Section 02300.

PART 3 EXECUTION

3.1 PREPARATION

   A. Protect and maintain benchmarks and survey control points during construction.
   B. Locate and clearly flag trees and vegetation to remain or to be relocated.
   C. Protect existing site improvements to remain during construction.

3.2 TREE PROTECTION

   A. Erect and maintain temporary fence around drip line of individual trees or around
      perimeter drip line of groups of trees to remain. Remove fence when construction is
      complete.
   B. Do not store construction materials, debris, or excavated material within drip line of
      remaining trees.
   C. Do not permit vehicles or equipment within drip line of remaining trees.
   D. Do not excavate within drip line of remaining trees, unless otherwise indicated.
   E. Where excavation for new construction is required within drip line of trees, hand
      clear and excavate to minimize damage to root systems. Use narrow-tine spading
      forks, comb soil to expose roots, and cleanly cut roots as close to excavation edge as
      possible.
      1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
3. Coat cut faces of roots more than 1-1/2-inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.

3.3 TREE PRUNING

A. Prune trees to balance the crown, and eliminate hazards. Perform main work to reduce sail effect through thinning, reducing end weights, shortening long heavy limbs, removing deadwood, weak limbs and sucker growth. Prune limbs back to an appropriate lateral branch.

B. Make final cuts at the outer edge of the branch collar in accordance with the arborist’s recommendations.

C. Perform pruning work in a safe and proper manner, adhering to CAL-OSHA and ANSI Standards.

3.4 ROOT PRUNING

A. Do not cut tree roots greater than 3-inch in diameter and less than 12-inches below ground level without approval of the Owner’s Representative.

B. Cut tree roots cleanly, as far from the trunk as possible, and not underneath any area where walkways are to be constructed. Prune tree roots minimum of 1’ back of any walkways, curb or asphalt to be constructed. Root pruning shall be to a depth of 18-inches.

C. Tree root prune using a Vermeer root-cutting machine. Obtain approval from the Owner’s Representative’s before using alternate equipment or techniques.

D. Complete tree root pruning prior to any excavation adjacent to the tree.

E. Do not expose tree roots to drying out. Cover root ends with soil or burlap and keep moist until the final backfill is completed.

3.5 TREE REMOVAL

A. Remove trees designated for removal prior to the construction of new improvements.
B. Perform tree removal work in a safe and proper manner, adhering to CAL-OSHA and ANSI Standards.

C. Remove or grind stumps to a minimum of 18-inches below finish subgrade. Remove surface roots to this depth within 24-inches of the tree trunk.

3.6 RESTORATION

A. Restore damaged improvements to their original condition, as acceptable to the Owner’s Representative.

B. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, as directed by the Owner’s Representative.
   1. Employ a qualified arborist, licensed in jurisdiction where the Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
   2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the Owner’s Representative.

3.7 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed or abandoned.

B. Arrange to shut off indicated utilities with utility companies or verify that utilities have been shut off.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner’s Representative or others unless authorized in writing by the Owner’s representative, and then only after arranging to provide temporary utility services according to requirements indicated.

D. Coordinate utility interruptions with utility company affected.

E. Do not proceed with utility interruptions without the permission of the Owner’s Representative’s and utility company affected. Notify Owner’s Representative and utility company affected two working days prior to utility interruptions.

F. Excavate and remove underground utilities that are indicated to be removed.

G. Securely close ends of abandoned piping with tight fitting plug or wall of concrete minimum 6-inches thick.
3.8 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

B. Remove trash, debris, logs, concrete, masonry and other waste materials.

C. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

D. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18-inches below subgrade.

E. Use only hand methods for grubbing within drip line of remaining trees.

3.9 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Remove trash, debris, weeds, roots, and other waste materials.

D. Stockpile topsoil materials designated to remain on site at a location approved by the Owner’s Representative at a location away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

E. Do not stockpile topsoil within drip line of remaining trees.

3.10 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, and gutters, as indicated. Where concrete slabs, curb, gutter and asphalt pavements are designated to be removed, remove bases and subbase to surface of underlying, undisturbed soil.
C. Unless the existing full-depth joints coincide with line of pavement demolition, neatly saw-cut to full depth the length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

D. Remove driveways, curbs, gutters and sidewalks by saw cutting to full depth. If saw cut falls within 30-inches of a construction joint, expansions joint, score mark or edge, remove material to joint, mark or edge.

3.11 BACKFILL

A. Place and compact material in excavations and depressions remaining after site clearing in conformance with Section 02300.

3.12 DISPOSAL

A. Unless specific soil stockpile or embankment fill areas are indicated on the plans or disposal or salvage instructions are noted on the plans, remove all surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the Owner’s property.

END OF SECTION
SECTION 02300

EARTHWORK

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Excavation and/or embankment from existing ground to subgrade, including soil sterilant, for roadways, driveways, parking areas, walks, paths, or trails and any other site improvements called for on the Plans.

1.2  SECTION EXCLUDES

A. Earthwork related to underground utility installation, see Section 02310.

1.3  RELATED SECTIONS

A. Section 02230, Tree Removal, Site Clearing Stripping and Grubbing.

B. Section 02310, Utility Trenching and Backfill.

C. Section 02320, Pavement Subbase and Base Courses.

D. Section 02620, Subdrainage.

1.4  RELATED DOCUMENTS

A. Geotechnical Report.

B. ASTM:
   1. D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
   2. D 1586, Method for Penetration Tests and Split-Barrel Sampling of Soils.
   3. D 2487, Classification of Soils for Engineering Purposes.
1.5 DEFINITIONS

A. Borrow: Approved soil material imported from off-site for use as Structural Fill or Backfill.

B. Excavation: Removal of material encountered above subgrade elevations.
   1. Authorized Over-Excavation: Excavation below subgrade elevations or beyond indicated horizontal dimensions as shown on plans or authorized by the Geotechnical Consultant.
   2. Unauthorized Over-Excavation: Excavation below subgrade elevations or beyond indicated horizontal dimensions without authorization by the Geotechnical Consultant. Unauthorized excavation shall be without additional compensation.

C. Geotechnical Testing Agency: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock definition testing, as documented according to ASTM D 3740 and ASTM E 548.

D. Structural Backfill: Soil materials approved by the Geotechnical Consultant and used to fill excavations resulting from removal of existing below grade facilities, including trees. See Section 02310 for trench backfill.

E. Structural Fill: Soil materials approved by the Geotechnical Consultant and used to raise existing grades.

F. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material ¾-cubic yards or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2-inches.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below grade.
H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, base or topsoil materials.

I. Unsuitable Material: Any soil material that is not suitable for a specific use on the Project. The Geotechnical Consultant will determine if a soil material is unsuitable.

J. Utilities: onsite underground pipes, conduits, ducts and cables.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01330.

B. Samples:
   1. If required by the Geotechnical Consultant, provide 40-pound samples sealed in airtight containers, tagged with source locations and suppliers of each proposed soil material from on-site or borrow sources. Do not import materials to the Project without written approval of the Geotechnical Consultant.
   2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Consultant.

C. Material Test Reports: Provide, from a qualified testing agency, the following test results showing compliance with the project requirements:

   1. Classification according to ASTM D 2487 of each onsite or borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve in conformance with ASTM D 1557 for each onsite or borrow soil material proposed for fill and backfill.

1.7 QUALITY ASSURANCE

A. Provide an independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock definition testing, as documented according to ASTM D 3740 and ASTM E 548.

B. Conform all work and materials to the recommendations or requirements of the Geotechnical Report and meet the approval of the Geotechnical Consultant.

C. Conform all work to the appropriate portion(s) of Caltrans Standard Specifications, Section 17 and 19.
D. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D 1557.

E. Perform excavation, filling, compaction and related earthwork under the observation of the Geotechnical Consultant. Materials placed without approval of the Geotechnical Consultant will be presumed to be defective and, at the discretion of the Geotechnical Consultant, shall be removed and replaced at no cost to the Owner. Notify the Geotechnical Consultant at least 24-hours prior to commencement of earthwork and at least 48 hours prior to testing.

F. The Geotechnical Consultant will perform observations and tests required to enable him to form an opinion of the acceptability of the Project earthwork. Correct earthwork that, in the opinion of the Geotechnical Consultant, does not meet the requirements of these Technical Specifications and the Geotechnical Report.

G. Upon completion of the construction work, certify that all compacted fills and foundations are in place at the correct locations, and have been constructed in accordance with sound construction practice. In addition, certify that the materials used are of the types, quality and quantity required by these Technical Specifications and the Geotechnical Report. The Contractor shall be responsible for the stability of all fills and backfills constructed by his forces and shall replace portions that in the opinion of the Geotechnical Consultant have been displaced or are otherwise unsatisfactory due to the Contractor’s operations.

H. Finish soil grade tolerance at completion of grading:
   1. Building and paved areas: +0.05
   2. Other areas: ±0.10 feet.

1.8 PROJECT CONDITIONS

A. Promptly notify the Owner’s Representative of surface or subsurface conditions differing from those disclosed in the Geotechnical Report. First notify the Owner’s Representative verbally to permit verification and extent of condition and then in writing. No claim for conditions differing from those anticipated in the Contract Documents and disclosed in the Geotechnical Report will be allowed unless the Contractor has notified the Owner’s Representative in writing of differing conditions prior to the Contractor starting work on affected items.

B. Protect open excavations, trenches, and the like with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.
C. Prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

D. Temporarily stock-pile fill material in an orderly and safe manner and in a location approved by the Owner’s Representative.

E. Provide dust and noise control in conformance with Section 02000.

F. Environmental Requirements: When unfavorable weather conditions necessitate interrupting earthwork operation, areas shall be prepared by compaction of surface and grading to avoid collection of water. Provide adequate temporary drainage to prevent erosion. After interruption, compaction specified in last layer shall be re-established before resuming work.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

B. Obtain approval of on-site soil materials and borrow materials to be used for structural fill or structural backfill from the Geotechnical Consultant.

C. On-Site Structural Fill and Structural Backfill: Soil or soil-rock mixture from on site excavations, free of deleterious substances. On-site structural fill and backfill shall not contain rocks or rock fragments over 6 inches in greatest dimension and not more than 15 percent shall be over 2-1/2 inches in greatest dimension and with an organic content less than 3.0 percent by weight.

D. Imported Structural Fill and Structural Backfill: Conform to the requirements of on-site structural fill. Material shall also be a non-expansive and predominantly granular soil or soil-rock mixture with plasticity index of 15 or less in accordance with ASTM D 4318 and an R-Value of 25 or greater.

2.2 SOIL STERILANT

A. Commercial chemical for weed control, registered by EPA. Provide granular, liquid or wet-able powder form.
PART 3  EXECUTION

3.1  GENERAL

A.  Conform to Section 19, Earthwork, Caltrans Standard Specifications as modified by the Contract Documents.

B.  Placement and compaction of material by flooding, ponding, or jetting will not be permitted.

C.  The use of explosives will not be permitted.

3.2  CONTROL OF WATER AND DEWATERING

A.  Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding the site and surrounding area.  Provide dewatering equipment necessary to drain and keep excavations and site free from water.

B.  Dewater during backfilling operation so that groundwater is maintained at least one foot below level of compaction effort.

C.  Obtain the Geotechnical Consultant’s approval for proposed control of water and dewatering methods.

D.  Protect subgrades from softening, undermining, washout and damage by rain or water accumulation.

E.  Reroute surface water runoff away from excavated areas.  Do not allow water to accumulate in excavations.

F.  Maintain dewatering system in place until dewatering is no longer required.

3.3  WET WEATHER CONDITIONS

A.  Do not prepare subgrade, place or compact soil materials if subgrade or materials are above optimum moisture content.

B.  If the Geotechnical Consultant allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the Geotechnical Consultant.
3.4 BRACING AND SHORING

A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the facility being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner’s Representative, submit details and calculations to the Owner’s Representative. The Owner’s Representative may forward the submittal to the Geotechnical Consultant, the Consulting Engineer and/or the California Division of Industrial Safety for their review. The Contractor's submittal shall include the basic design, assumed soils conditions and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations related to the proposed facility shall precede a response to the submittal by the Owner’s Representative.

D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the position or operation of the facility being constructed or adjacent utilities and facilities.

3.5 EXCAVATION

A. Excavate earth and rock to lines and grades shown on drawings and to the neat dimensions indicated on the Plans, required herein or as required to satisfactorily compact backfill.

B. Remove and dispose of large rocks, pieces of concrete and other obstructions encountered during excavation.

C. Where forming is required, excavate only as much material as necessary to permit placing and removing forms.

D. Provide supports, shoring and sheet piles required to support the sides of excavations or for protection of adjacent existing improvements.

3.6 REMOVAL OF EXISTING FILLS AND UNSUITABLE MATERIAL

A. Over-excavate areas of existing fills and other unsuitable material encountered during mass grading as directed by the Geotechnical Consultant.
B. Compensation for increased removal widths and depths that are not required by the Geotechnical Consultant will not be considered, except when such increase is necessary for protection of life and property as determined by and approved by the Owner.

C. The Geotechnical Consultant will provide written approval for each excavation prior to placement of fill. Allow adequate time after excavation and before filling for the Geotechnical Consultant’s review and written approval and, if necessary, time for the Owner’s Representative to conduct as built survey prior to placing fill. Basis for calculating the quantity of material excavated or placed may be the difference between the grading shown on the Plan and an as built survey of the grading.

3.7 GRADING

A. Uniformly grade the Project to the elevations shown on plans

B. Finish ditches, gutters and swales to the sections, lines and grades indicated and to permit proper surface drainage.

C. Round tops and bottoms of slopes as indicated or to blend with existing contours.

3.8 SUBGRADE PREPARATION

A. Install underground utilities and service connections prior to final preparation of subgrade and placement of base materials for final surface facilities. Extend services so that final surface facilities are not disturbed when service connections are made.

B. Prepare subgrades under the structural section of paved areas, curbs, gutters, walks, structures, other surface facilities and areas to receive structural fill.

C. Prepare subgrades for the structural section of paved areas, curbs and gutters by plowing or scarifying surface at least 6 inches below final subgrade elevations and 5-feet beyond edge of pavement unless specified otherwise by the Geotechnical Consultant. Uniformly moisture condition to obtain optimum moisture contents. Break clods and condition surface by harrowing or dry rolling. Remove boulders, hard ribs and solid rock. Prepare earth uniform for full depth and width of subgrade.

D. Protect utilities from damage during compaction of subgrades and until placement of final pavements or other surface facilities.

E. Obtain the Geotechnical Consultant’s approval of subgrades prior to placing pavement structural section.
3.9 PLACEMENT OF STRUCTURAL FILL

A. Obtain the Geotechnical Consultant’s approval of surface to receive structural fill prior to placement of structural fill material.

B. Place structural fill on prepared subgrade.

C. Spread structural fill material in uniform lifts not more than 8-inches in un-compacted thickness and compact.

D. Place structural fill material to suitable elevations above grade to provide for anticipated settlement and shrinkage.

E. Overbuild fill slopes, as required by the Geotechnical Consultant, to obtain required compaction. Remove excess material to lines and grades indicated.

F. Do not drop fill on structures. Do not backfill around, against or upon concrete or masonry structures until structure has attained sufficient strength to withstand loads imposed and the horizontal structural system had been installed.

3.10 KEYWAYS AND BENCHES

A. Provide keyways as indicated for fill slopes steeper than 6 horizontal to 1 vertical. Extend keyway 5-feet minimum into competent, undisturbed soil or 3-feet minimum into competent, undisturbed rock as directed by the Geotechnical Consultant.

B. Place subsurface drains in bottom of keyway in conformance with Section 02620.

C. Bench subgrade as indicated above toe of fill.

D. Place subsurface drains at benches every 20 vertical feet or as directed by the Geotechnical Consultant.

3.11 PAD FINISH GRADING

A. Finish pads to lines and grades indicated.

3.12 COMPACTION AND TESTING

A. Do not compact by ponding, flooding or jetting.
B. Compact soils at optimum water content. Aerate material if it is too wet. Add water to material if it is too dry. Thoroughly mix lifts before compaction to ensure uniform moisture distribution.

C. Perform compaction using rollers, pneumatic or vibratory compactors or other equipment and mechanical methods approved by the Geotechnical Consultant.

D. Compaction requirements:
1. Compact structural fills less than 5-feet thick to 90 percent compaction.
2. Compact structural fill 5-feet thick or greater to 95 percent compaction.
3. Compact the upper 6 inches of subgrade soils beneath pavements, curbs and gutters to 95 percent compaction. Extend compaction 5-feet beyond pavement edges unless specified otherwise by the Geotechnical Consultant.
4. Compact the upper 6-inches of subgrade soils under walks, structures and areas to receive structural fill to 90 percent compaction.

3.13 SOIL STERILIZATION

A. Apply soil sterilant to areas indicated, such as beneath asphalt concrete pavement, brick pavement, concreter pavement and at grade concrete slabs, including sidewalks, curbs and gutters. Also where indicated apply soil sterilant below expansion and control joints and at areas where pipes, ducts or other features penetrate slabs.

B. Apply soil sterilant uniformly and at the rates recommended by the manufacturer.

C. Apply soil sterilant to prepared subgrade, or after installation of aggregate base as recommended by the manufacturer.

3.14 DISPOSAL

A. Unless specific stockpile or embankment fill areas are indicated on the plans or disposal instructions are noted on the plans, lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Owner.

END OF SECTION
SECTION 02310
UTILITY TRENCHING AND BACKFILL

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Excavation, bedding, and backfill of underground storm drain, sanitary sewer and water piping and associated structures.

1.2  SECTION EXCLUDES

A. Drainage fill material and placement around subdrains. See Section 02620.

B. Trenching and backfill for other utilities such as underground electric, telephone, gas, cable TV, etc.

1.3  RELATED SECTIONS

A. Section 02300, Earthwork.

B. Section 02510, Water Distribution.

C. Section 02530, Sanitary Sewer System.

D. Section 02630, Storm Drainage System.

E. Section 02620, Subdrainage.

1.4  RELATED DOCUMENTS

A. Geotechnical Report.

B. ASTM:
   1. C 33, Specification for Concrete Aggregates.
7. D 2487, Classification of Soils for Engineering Purposes.


D. Caltrans Standard Specifications:
   1. Section 19, Earthwork.
   2. Section 26, Aggregate Bases.
   3. Section 68, Subsurface Drains.
   4. Section 88, Engineering Fabrics.

E. CAL/OSHA, Title 8.

1.5 DEFINITIONS

A. AC: Asphalt Concrete.


C. Bedding: Material from bottom of trench to bottom of pipe.

D. CDF: Controlled Density Fill.

E. DIP: Ductile Iron Pipe.

F. Initial Backfill: Material from bottom of pipe to 12-inches above top of pipe.

G. PCC: Portland Cement Concrete.

H. RCP: Reinforced Concrete Pipe.

I. Springline of Pipe: Imaginary line on surface of pipe at a vertical distance of ½ the outside diameter measured from the top or bottom of the pipe.

J. Subsequent Backfill: Material from 12-inches above top of pipe to subgrade of surface material or subgrade of surface facility or to finish grade.
K. Trench Excavation: Removal of material encountered above subgrade elevations and within horizontal trench dimensions.
   1. Authorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions as shown on plans or authorized by the Geotechnical Consultant.
   2. Unauthorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions without authorization by the Geotechnical Consultant. Unauthorized excavation shall be without additional compensation.

L. Utility Structures:
   1. Storm drainage manholes, catch basins, drop inlets, curb inlets, vaults, etc.
   2. Sanitary sewer manholes, vaults, etc.
   3. Water vaults, etc.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01330.

B. Product Data:
   1. Grading and quality characteristics showing compliance with requirements for the Work.
   2. Certify that material meets requirements of the Project.

C. Samples:
   1. If required by the Geotechnical Consultant, provide 40-pound samples of all imported trench bedding and backfill material sealed in airtight containers, tagged with source locations and suppliers of each proposed material. Do not import materials to Project without written approval of the Geotechnical Consultant.
   2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Consultant and the Owner’s Representative’s.

1.7 QUALITY ASSURANCE

A. Conform all work and materials to the recommendations or requirements of the Geotechnical Report and meet the approval of the Geotechnical Consultant.

B. Conform all work to the appropriate portion(s) of the Caltrans Standard Specifications, Section 19.
C. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D 1557.

D. The Geotechnical Consultant will perform observations and tests required to enable him to form an opinion of the acceptability of the trench backfill. Correct the trench backfill that, in the opinion of the Geotechnical Consultant, does not meet the requirements of these Technical Specifications and the Geotechnical Report.

1.8 PROJECT CONDITIONS

A. Promptly notify the Owner’s Representative of surface or subsurface conditions differing from those disclosed in the Geotechnical Report. First notify the Owner’s Representative verbally to permit verification and extent of condition and then in writing. No claim for conditions differing from those anticipated in the Contract Documents and disclosed in the Geotechnical Report will be allowed unless Contractor has notified the Owner’s Representative in writing of differing conditions prior to contractor starting work on affected items.

B. Protect open, trenches, and utility structure excavations with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.

C. Stockpile on-site and imported backfill material temporarily in an orderly and safe manner.

D. Provide dust and noise control in conformance with Section 02000, Supplemental General Requirements for Civil Improvements.

PART 2 PRODUCTS

2.1 PIPE BEDDING AND INITIAL BACKFILL

A. ASTM D 2321, Class II.
   1. Clean and free of clay, silt or organic matter.

B. Permeable Material: Conform to Section 68-1.025 of Caltrans Standard Specifications, Class 2.

C. Class 2 Aggregate Base: Conform to Section 26 of Caltrans Standard Specifications, ¾-inch maximum.

2.2 WARNING TAPE

A. Non-detectable 3-inch warning tape made of solid film. See Sections 02510 and 15486 for specific lettering applicable to each type of utility line.

2.3 SUBSEQUENT BACKFILL

A. Conform to on-site or imported structural backfill in Section 02300, Earthwork.

2.4 CONTROLLED DENSITY FILL (CDF) (IN TRENCHES)

A. Provide non-structural CDF, from bottom of trench to finish subgrade of subbase or base material, that can be excavated by hand and produce unconfined compressive 28-day strengths from 50-psi to a maximum of 150-psi. Provide aggregate no larger than 3/8-inch top size. The 3/8-inch aggregate shall not comprise more than 30% of the total aggregate content.

B. Cement: Conform to the standards as set forth in ASTM C-150, Type II Cement.

C. Fly Ash: Conform to the standards as set forth in ASTM C-618, for Class F pozzolan. Do not inhibit the entrainment of air with the fly ash.

D. Air Entraining Agent: Conform to the standards as set forth in ASTM C-260.

E. Aggregates need not meet the standards as set forth in ASTM C-33. Any aggregate, producing performances characteristics described herein will be accepted for consideration. The amount of material passing a #200 sieve shall not exceed 12% and no plastic fines shall be present.

F. Provide CDF that is a mixture of cement, Class F pozzolan, aggregate, air entraining agent and water. CDF shall be batched by a ready mixed concrete plant and delivered to the job site by means of transit mixing trucks.

G. The Contractor shall determine the actual mix proportions of the controlled density fill to meet job site conditions, minimum and maximum strengths, and unit weight. Entrained air content shall be a minimum of 4.0%. The actual entrained air content shall be established for each job with the materials and aggregates to be used to meet the placing and unit weight requirements. Entrained air content may be as high as 20% for fluidity requirements.

H. Mix design shall meet the Geotechnical Consultant’s approval.
2.5 CONCRETE STRUCTURE BEDDING AND BACKFILL

A. Precast Structures: Same materials to the same heights as specified for pipe bedding and backfill, or other material approved by the Geotechnical Consultant.

B. Poured-in-Place Structures:
   1. Bedding: Bedding shall meet the approval of the Geotechnical Consultant. In general, bedding is not required, pour bases against undisturbed native earth in cut areas and against engineered fill compacted to 90% relative compaction in embankment areas.
   2. Side Backfill: On-site or imported structural fill meeting the requirements given in Section 02300.

2.6 FILTER FABRIC

A. Filter Fabric:
   2. Mirifi 140N (Mirifi Inc., Charlotte, NC) (Tel. 800-438-1855) or equal.

PART 3 EXECUTION

3.1 TRENCHING AND EXCAVATION

A. Existing PCC or AC Areas: Cut PCC or AC to full depth at a minimum distance of 12-inches beyond the edge of the trench.

B. Excavate by hand or machine. For gravity systems begin excavation at the outlet end and proceed upstream. Excavate sides of the trench parallel and equal distant from the centerline of the pipe. Hand trim excavation. Remove loose matter.

C. Excavation Depth for Bedding: Minimum of 4-inches below bottom of pipe or as otherwise allowed or required by the Geotechnical Consultant, except that bedding is not required for nominal pipe diameters of 2-inches or less.

D. Excavation Width at Springline of Pipe:
   1. Up to a nominal pipe diameter of 24-inches: Minimum of twice the outside pipe diameter, or as otherwise allowed or required by the Geotechnical Consultant.
   2. Nominal pipe diameter of 30-inches through 36-inches: Minimum of the outside pipe diameter plus 2-feet, or as otherwise allowed or required by the Geotechnical Consultant.
   3. Nominal pipe diameter of 42-inches through 60-inches: Minimum of the outside pipe diameter plus 3-feet, or as otherwise allowed or required by the Geotechnical Consultant.
E. Over-Excavations: Backfill trenches that have been excavated below bedding design subgrade, with approved bedding material.

F. Comply with the Owner’s Representative’s limitations on the amount of trench that is opened or partially opened at any one time. Do not leave trenches open overnight without the approval of the Owner’s Representative.

G. Where forming is required, excavate only as much material as necessary to permit placing and removal of forms.

H. Bottoms of trenches will be subject to testing by Geotechnical Consultant. Correct deficiencies as directed by the Geotechnical Consultant.

I. Grade bottom of trench to provide uniform thickness of bedding material and to provide uniform bearing and support for pipe along entire length. Remove stones to avoid point bearing.

3.2 CONTROL OF WATER AND DEWATERING

A. Be solely responsible for dewatering trenches and excavations and subsequent control of ground and surface water. Provide and maintain such pumps or other equipment as may be necessary to control ground water and seepage to the satisfaction of the Geotechnical Consultant and the Owner’s Representative until backfilling is completed.

B. Dewater during backfilling operation so that groundwater is maintained a least one foot below level of compaction effort.

C. Obtain the Geotechnical Consultant’s approval for proposed control of water and dewatering methods.

D. Reroute surface water runoff away from open trenches and excavations. Do not allow water to accumulate in trenches and excavations.

E. Maintain dewatering system in place until dewatering is no longer required.

3.3 BRACING AND SHORING

A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to
prevent damage to the pipes and appurtenances being constructed; and to prevent
damage to adjacent structures or facilities. Remove all bracing and shoring upon
completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner’s
Representative, submit details and calculations to the Owner’s Representative. The
Owner’s Representative may forward the submittal to the Geotechnical Consultant,
the Consulting Engineer and/or the California Division of Industrial Safety for their
review. The Contractor's submittal shall include the basic design, assumed soils
conditions and estimation of forces to be resisted, together with plans and
specifications of the materials and methods to be used, and shall be prepared by a
civil engineer or structural engineer registered in California. No excavations in
trench section or around structures shall precede a response to the submittal by the
Owner’s Representative.

D. Be solely responsible for installing and extracting the sheathing in a manner which
will not disturb the line, grade, or backfill compaction or operation of the utility being
installed or adjacent utilities and facilities.

3.4 PIPE BEDDING

A. Obtain approval of bedding material from the Geotechnical Consultant.

B. Accurately shape bedding material to the line and grade called for on the Plans.
Carefully place and compact bedding material to the elevation of the bottom of the
pipe in layers not exceeding 8-inches in loose thickness. Compact bedding material
at optimum water content to 90% relative compaction unless specified otherwise on
the Plans or by the Geotechnical Consultant. Compact by pneumatic tampers or other
mechanical means approved by the Geotechnical Consultant. Jetting or ponding of
bedding material will not be permitted.

C. Upon completion of bedding operations, and prior to the installation of pipe, notify
the Geotechnical Consultant, who will inspect the bedding layer. Do not commence
pipe laying until the Geotechnical Consultant has approved the bedding.

3.5 WARNING TAPE

A. For all water lines and gas lines, install tape approximately 1-foot above and along the
centerline of the pipe.

B. Where tape is not continuous, lap tape ends a minimum of 2-feet.
3.6 BACKFILLING

A. Obtain approval of backfill material from Geotechnical Consultant.

B. Bring initial backfill up simultaneously on both sides of the pipe, so as to prevent any displacement of the pipe from its true alignment. Carefully place and compact initial backfill material to an elevation of 12-inches above the top of the pipe in layers not exceeding 8-inches in loose thickness. Compact initial backfill material at optimum water content to 90% relative compaction unless specified otherwise on the Plans or by the Geotechnical Consultant. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Consultant. Jetting or ponding of initial backfill material will not be permitted.

C. Bring subsequent backfill to subgrade or finish grade as indicated. Carefully place and compact subsequent backfill material to the proper elevation in layers not exceeding 8-inches in loose thickness. Compact subsequent backfill material sat optimum water content to 90% relative compaction, except that the upper 36-inches in areas subject to vehicular traffic shall be compacted to at least 95% relative compaction, unless specified otherwise on the Plans or by the Geotechnical Consultant. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Consultant. Jetting or ponding of subsequent backfill material will not be permitted.

D. Do not use compaction equipment or methods that produce horizontal or vertical earth pressures which may cause excessive pipe displacement or damage the pipe.

E. Utility backfill shall be inspected and tested by the Geotechnical Consultant during placement. Cooperate with the Geotechnical Consultant and provide working space for such tests in operations. Backfill not compacted in accordance with these specifications shall be re-compacted or removed as necessary and replaced to meet the specified requirements, to the satisfaction of the Geotechnical Consultant and the Owner’s Representative prior to proceeding with the Project.

3.7 CLEANUP

A. Upon completion of utility earthwork all lines, manholes catch basins, inlets, water meter boxes and other structures shall be thoroughly cleaned of dirt, rubbish, debris and obstructions of any kind to the satisfaction of the Owner’s Representative.

END OF SECTION
SECTION 02320

PAVEMENT SUBBASE AND BASE COURSES

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Aggregate subbase and base.

B.  Cement treated base.

C.  Lime stabilization.

1.2  RELATED SECTIONS

A.  Section 02300, Earthwork.

B.  Section 02750, Asphalt Concrete Pavement.

1.3  RELATED DOCUMENTS

A.  Geotechnical Report.

B.  Caltrans Standard Specifications:
   1.  Section 24, Lime Stabilization.
   2.  Section 25, Aggregate Subbases.
   3.  Section 26, Aggregate Bases.
   4.  Section 27, Cement Treated Bases.

C.  ASTM:
   1.  D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.4  DEFINITIONS


1.5  SUBMITTALS

A.  Follow submittal procedure outlined in Section 01330.
B. Submit material certificates signed by the material producer and the Contractor, certifying that each material item complies with, or exceeds the specified requirements.

1.6 QUALITY ASSURANCE

A. Do not mix or place cement treated base when the temperature is below 36 degrees F or when the ground is frozen.

B. Conform to the appropriate portions of the Geotechnical Report, these Specifications and Section 19 of Caltrans Standard Specifications.

C. Finish surface of the prepared subgrade to receive aggregate subbase, aggregate base or cement treated base, shall be as specified in Section 02300.

D. Finish surface of material to be stabilized prior to lime treatment shall be as specified in Section 24-1.04 of Caltrans Standard Specifications.

E. Finish surface of the stabilized material after lime treatment shall be as specified in Section 24-1.08 of Caltrans Standard Specifications.

F. Do not project the finish surface of aggregate subbase above the design subgrade.

G. Finish surface of aggregate base shall be 0 to - 0.05-feet.

H. Finish surface of cement treated base shall be as specified in Section 27 of Caltrans Standard Specifications.

I. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM Designation D1557.

PART 2 PRODUCTS

2.1 FILL MATERIAL

A. If fill material is required to restore the previously constructed subgrade to its proper elevation, provide structural fill material specified in Section 02300.
2.2 AGGREGATE SUBBASE

A. Material: Caltrans Standard Specification Section 25. Class of aggregate is as shown on the Plans.
   1. Class 1, 2, or 3: Section 25-1.02A.
   2. Class 4: Section 25-1.02B.
   3. Class 5: Section 25-1.02C.

2.3 AGGREGATE BASE

   1. Class 2, Section 26-1.02A. Grading, Section 26-1.02A.

2.4 CEMENT TREATED BASE

A. Materials: Caltrans Standard Specification Section 27-1.02, Class designation and portland cement content as shown on the Plans.

2.5 LIME STABILIZATION

A. Lime Treatment Material: Conform to Section 24-1.02 and 24-1.03 of Caltrans Standard Specifications.

PART 3 EXECUTION

3.1 SOIL STERILANT

A. Furnish and apply to areas indicated in accordance with Section 02300.

3.2 AGGREGATE SUBBASE

A. Spreading and Compacting: Sections 25-1.04 and 25-1.05 of Caltrans Standard Specifications.

3.3 AGGREGATE BASE

A. Watering, Spreading and Compacting: Section 26-1.035, 26-1.04 and 26-1.05 of Caltrans Standard Specifications.
3.4 CEMENT TREATED BASE

A. Cement treated base shall be Class A or Class B, road mixed or plant mixed as shown on the Plans.

B. Deposit and mix in accordance with Section 27-1.04 for road mixed or 27-1.05 for plant mixed of Caltrans Standard Specifications.

C. Spread, compact and cure in accordance with Sections 27-1.06 through 27-1.10 of Caltrans Standard Specifications.

3.5 LIME STABILIZATION

A. Performing the stabilization shall conform to Section 24-1.05 through 24-1.09 of Caltrans Standard Specifications and the following:
   1. Add lime in the amount indicated on the Plans.
   2. Lime treat subgrade soils from back of curb to back of curb to a minimum depth as indicated on the Plans.
   3. Mix in two mixing periods, both with the tines lowered to the same depth. Both mixing periods shall be monitored and verified by the Geotechnical Consultant. The second mixing shall occur at about 24 hours after the initial mixing.
   4. Compact and grade the lime mixed subgrade immediately after the second mixing.
   5. Compact the lime treated subgrade to 93 percent as determined by ASTM D1557.
   6. After application of the curing seal, do not allow traffic on the lime treated material for a period of 7 days in lieu of the 3 days specified in Section 24-1.03 of Caltrans Standard Specifications.
   7. Proof-roll the stabilized subgrade after compacting to confirm that a non-yielding surface has been achieved. Yielding areas, if any, shall be mitigated. Mitigation could consist of over-excavation, utilization of stabilization fabric, or chemical treatment. Each case shall be addressed individually in the field by the Geotechnical Consultant.

END OF SECTION
SECTION 02487

SOLDIER PILE WALL

DEVELOPED FOR USE WITH SOLDIER PILE WALLS
DESIGNED BY BIGGS CARDOSA ASSOCIATES

PART 1   GENERAL

1.1 DESCRIPTION OF WORK

A. The work included in this section consists of furnishing all material, supplies, equipment, tools, transportation and facilities, and performing all labor and services necessary for, and required in connection with, soldier pile wall construction as described in the Caltrans Standard Specifications, and this section of the technical specifications and the accompanying drawings, or reasonably implied therefrom, except as hereinafter specifically excluded.

1.2 REFERENCE STANDARDS AND QUALITY ASSURANCE

A. The work embraced herein shall conform to the provisions in the Standard Specifications dated May 2006, and the Standard Plans dated May 2006, of the State of California, Department of Transportation insofar as the same may apply, and these technical specifications. In case of conflict between the Standard Specifications and these technical specifications, the technical specifications shall take precedence over and shall be used in lieu of the conflicting portions.

B. Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications, the applicable soils report(s) by Miller Pacific Engineering Group and these technical specifications.

C. See Section 3.0, “EXECUTION” of this special provision for quality assurance requirements. A minimum of 48 hours notice shall be given to the Engineer by the Contractor prior to any work requiring inspection. Failure to provide at least 48 hours notice may result in the Engineer rejecting the work. Said notice shall include the date and time of the scheduled work.

1.3 SUBMITTALS

A. Certificates of compliance submittals shall conform to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.
B. Working drawings submittals shall conform to the provisions in Section 5-1.02, “Plans and Working Drawings” of the Standard Specifications. Shop drawings shall be submitted sufficiently in advance of the start of the affected work to allow time for review by the Engineer and correction by the Contractor of the drawings without delaying the work.

C. Concrete Mix Designs, including mix design proportions, aggregate gradings, and certificates of compliance for aggregates, cement, water and mineral and chemical admixtures.

D. Steel Piling:
   1. Certificates of compliance for structural shapes and plates.
   2. Working drawings for steel piling.

E. Tieback Anchors:
   1. Working drawings of the prestressing system proposed for use. The submittal of reduced prints of corrected original tracings will not be required for tieback anchor installations.
   2. Grout Mix Design, including mix design proportions, aggregate gradings, and certificates of compliance for aggregates, cement, water and mineral and chemical admixtures.
   3. Certificates of compliance for prestressing strands, and/or bars.
   4. Certificates of compliance for smooth and corrugated plastic sheathing.
   5. Certificate of compliance for the corrosion inhibiting grease
   6. The Contractor shall furnish to the Engineer for approval, documentation and calibration results indicating the date and results of the Caltrans Transportation Laboratory Calibration for the jack and pressure gages to be used for tieback anchor stressing. The Contractor shall furnish to the Engineer the certified calibration results a minimum of 5 working days prior to stressing.
   7. The Contractor shall perform the measuring and recording for each tieback test and shall furnish the Engineer copies of the recorded tieback movements.

G. Progress Schedule, including schedule updates produced as the work progresses.

H. Painting Quality Work Plan:

1. Prior to performing any painting or paint removal, the Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 3 copies of a separate Painting Quality Work Plan (PQWP) for each item of work for which painting or paint removal is to be performed. As a minimum, each PQWP shall include the following:

   a. The name of each Contractor or subcontractor to be used.
   b. One copy each of all current "SSPC: The Society for Protective Coatings" specifications or qualification procedures which are applicable to the painting or paint removal to be performed. These documents shall become the permanent property of the Department.
   c. A copy of the coating manufacturer's guidelines and recommendations for surface preparation, painting, drying, curing, handling, shipping, and storage of painted structural steel, including testing methods and maximum allowable levels for soluble salts.
   d. Proposed methods and equipment to be used for any paint application.
   e. Proof of each of any required certifications, SSPC-QP 1 or SSPC-QP 3.

1) In lieu of certification in conformance with the requirements in SSPC-QP 1 for this project, the Contractor may submit written documentation showing conformance with the requirements in Section 3, "General Qualification Requirements," of SSPC-QP 1.

2) In lieu of certification in conformance with the requirements in SSPC-QP 3 for this project, the Contractor may submit written documentation showing conformance with the requirements in Section 3, "General Qualification Requirements," of SSPC-QP 3.

   f. Proposed methods to control environmental conditions in accordance with the manufacturer's recommendations and these technical specifications.
   g. Proposed methods to protect the coating during curing, shipping, handling, and storage.
   h. Proposed rinse water collection plan.
   i. A detailed paint repair plan for the repair of damaged areas.
   j. Procedures for containing blast media and water during application of coatings and coating repair of erected steel.
   k. Examples of proposed daily reports for all testing to be performed, including type of testing, location, lot size, time, weather conditions, test personnel, and results.
2. No painting or paint removal shall be performed until the PQWP for that work is reviewed by the Engineer.

3. The Engineer's review of the Contractor's PQWP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications.

I. Non-Prequalified Joint Weld Details: When joint weld details that are not prequalified to the details of Section 3 of AWS D1.1 or to the details of Figure 2.4 or 2.5 of AWS D1.5 are proposed for use in the work, the joint details, their intended locations, and the proposed welding parameters and essential variables, shall be approved by the Engineer. Upon approval of the proposed joint detail locations and qualification of the proposed joint details, welders and welding operators using these details shall perform a qualification test plate using the WPS variables and the joint detail to be used in production. The test plate shall have the maximum thickness to be used in production and a minimum length of 18 inches. The test plate shall be mechanically and radiographically tested. Mechanical and radiographic testing and acceptance criteria shall be as specified in the applicable AWS codes.

J. Qualification Tests for Welding Procedure Specifications: The Engineer will witness all qualification tests for WPSs that were not previously approved by the Department of Transportation. Unless otherwise specified, an approved independent third party will witness the qualification tests for welders or welding operators. The independent third party shall be a current CWI and shall not be an employee of the contractor performing the welding. The Contractor shall notify the Engineer one week prior to performing any qualification tests. Witnessing of qualification tests by the Engineer shall not constitute approval of the intended joint locations, welding parameters, or essential variables.

K. Welding Quality Control Plan:

1. Prior to submitting the Welding Quality Control Plan (WQCP) required herein, a prewelding meeting between the Engineer, the Contractor's QCM, and a representative from each entity performing welding or inspection for this project, shall be held to discuss the requirements for the WQCP.

2. The Contractor shall submit to the Engineer, in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications, 2 copies of a separate WQCP for each subcontractor or supplier for each item of work for which welding is to be performed.

3. No welding shall be performed until the WQCP is approved in writing by the Engineer.
4. An amended WQCP or any addendum to the approved WQCP shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved WQCP. An amended WQCP or addendum will be required for revisions to the WQCP, including but not limited to a revised WPS; additional welders; changes in NDT firms, QC, or NDT personnel or procedures; or updated systems for tracking and identifying welds. Work affected by the proposed revisions shall not be performed until the amended WQCP or addendum has been approved.

5. Information regarding the contents, format, and organization of a WQCP, is available at the Caltrans Transportation Laboratory and at:

http://www.dot.ca.gov/hq/esc/Translab/smbresources.htm

6. After final approval of the WQCP, amended WQCP, or addendum, the Contractor shall submit 7 copies to the Engineer of the approved documents. A copy of the Engineer approved document shall be available at each location where welding is to be performed.

L. Welding Daily Production Logs: A daily production log for welding shall be kept for each day that welding is performed. The log shall clearly indicate the locations of all welding. The log shall include the welders' names, amount of welding performed, any problems or deficiencies discovered, and any testing or repair work performed, at each location. The daily report from each QC Inspector shall also be included in the log.

M. Welding Reports:

1. The following items shall be included in a Welding Report that is to be submitted to the Engineer within 2 weeks following the performance of any welding:

   a. A daily production log.
   b. Reports of all visual weld inspections and NDT.
   c. Radiographs and radiographic reports, and other required NDT reports.
   d. A summary of welding and NDT activities that occurred during the reporting period.
   e. Reports of each application of heat straightening.
   f. A summarized log listing the rejected lengths of weld by welder, position, process, joint configuration, and piece number.
   g. Documentation that the Contractor has evaluated all radiographs and other nondestructive tests and corrected all rejectable deficiencies, and that all repaired welds have been reexamined using the required NDT and found acceptable.
2. The following information shall be clearly written on the outside of radiographic envelopes: name of the QCM, name of the nondestructive testing firm, name of the radiographer, date, contract number, complete part description, and all included weld numbers, report numbers, and station markers or views, as detailed in the WQCP. In addition, all interleaves shall have clearly written on them the part description and all included weld numbers and station markers or views, as detailed in the WQCP. A maximum of 2 pieces of film shall be used for each interleave.

3. Reports of all visual inspections and NDT shall be signed by the inspector or technician and submitted daily to the QCM for review and signature prior to submittal to the Engineer. Corresponding names shall be clearly printed or typewritten next to all signatures. Reports of all NDT, whether specified, additional, or informational, performed by the Contractor shall be submitted to the Engineer.

4. The Engineer will review the Welding Report to determine if the Contractor is in conformance with the WQCP and will respond in writing. Prior to receiving notification from the Engineer of the Contractor's conformance with the WQCP, the Contractor may encase in concrete or cover welds for which the Welding Report has been submitted. However, should the Contractor elect to encase or cover those welds prior to receiving notification from the Engineer, it is expressly understood that the Contractor shall not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection.

N. Welding Problem/Deficiency Reports:

1. The Engineer shall be notified immediately in writing when welding problems, deficiencies, base metal repairs, or any other type of repairs not submitted in the WQCP are discovered, and also of the proposed repair procedures to correct them. For requests to perform second-time repairs or repairs of cracks, the Contractor shall include an engineering evaluation of the proposed repair. The engineering evaluation, at a minimum, shall address the following:

   a. What is causing each defect?
   b. Why the repair will not degrade the material properties?
   c. What steps are being taken to prevent similar defects from happening again?

2. No remedial work shall begin until the repair procedures are approved in writing by the Engineer.
O. Welding Certificate of Compliance: The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each item of work for which welding was performed. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work, have been performed in conformance with the details shown on the plans, the Standard Specifications, and these technical specifications.

PART 2 PRODUCTS

A. See Section 1.2, “REFERENCE STANDARDS AND QUALITY ASSURANCE” and Section 3.0, “EXECUTION” of this special provision for product compliance requirements.

PART 3 EXECUTION

3.1 AMENDMENTS TO CALTRANS STANDARD SPECIFICATIONS

Amendments to the Standard Specifications set forth in these technical specifications shall be considered as part of the Standard Specifications for the purposes set forth in Section 5-1.04, "Coordination and Interpretation of Plans, Standard Specifications and Technical specifications," of the Standard Specifications. Whenever either the term "Standard Specifications is amended" or the term "Standard Specifications are amended" is used in the technical specifications, the text or table following the term shall be considered an amendment to the Standard Specifications. In case of conflict between such amendments and the Standard Specifications, the amendments shall take precedence over and be used in lieu of the conflicting portions.

SECTION 19: EARTHWORK

Issue Date: January 5, 2007

The first paragraph of Section 19-3.025C, "Soil Cement Bedding," of the Standard Specifications is amended to read:

- Cementitious material used in soil cement bedding shall conform to the provisions in Section 90-2.01, "Cementitious Materials." Supplementary cementitious material will not be required.

The fourth paragraph of Section 19-3.025C, "Soil Cement Bedding," of the Standard Specifications is amended to read:

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• The aggregate, cementitious material, and water shall be proportioned either by weight or by volume. Soil cement bedding shall contain not less than 282 pounds of cementitious material per cubic yard. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

The first paragraph of Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications is amended to read:

• Slurry cement backfill shall consist of a fluid, workable mixture of aggregate, cementitious material, and water.

The fifth paragraph of Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications is amended to read:

• Cementitious material shall conform to the provisions in Section 90-2.01, "Cementitious Materials." Supplementary cementitious material will not be required.

The eighth paragraph of Section 19-3.062, "Slurry Cement Backfill," of the Standard Specifications is amended to read:

• The aggregate, cementitious material, and water shall be proportioned either by weight or by volume. Slurry cement backfill shall contain not less than 188 pounds of cementitious material per cubic yard. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

SECTION 51: CONCRETE STRUCTURES

Issue Date: March 16, 2007

The first sentence of the eleventh paragraph of Section 51-1.05, "Forms," of the Standard Specifications is amended to read:

• Form panels for exposed surfaces shall be furnished and placed in uniform widths of not less than 3 feet and in uniform lengths of not less than 6 feet, except at the end of continuously formed surfaces where the final panel length required is less than 6 feet.

The first sentence of the eleventh paragraph of Section 51-1.06C, "Removing Falsework," of the Standard Specifications is amended to read:

• Falsework for box culverts and other structures with decks lower than the roadway pavement and with span lengths of 14 feet or less shall not be released until the last placed concrete has attained a compressive strength of 1,600 psi, provided that curing of the concrete is not interrupted.
The fourth paragraph in Section 51-1.12D, "Sheet Packing, Preformed Pads, and Board Fillers," of the Standard Specifications is amended to read:

- Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a minimum flexural strength of 35 psi determined in conformance with the requirements in ASTM Designation: C 203 and a compressive yield strength of between 16 and 40 psi at 5 percent compression. Surfaces of expanded polystyrene against which concrete is placed shall be faced with hardboard. Hardboard shall be 1/8 inch minimum thickness, conforming to ANSI A135.4, any class. Other facing materials may be used provided they furnish equivalent protection. Boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

The table in the sixth paragraph of Section 51-1.12F, "Sealed Joints," of the Standard Specifications is amended to read:

<table>
<thead>
<tr>
<th>Movement Rating (MR)</th>
<th>Seal Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR ≤ 5/8 inch</td>
<td>Type A or Type B</td>
</tr>
<tr>
<td>5/8 inch &lt; MR ≤ 1-1/4 inches</td>
<td>Type A (silicone only) or Type B</td>
</tr>
<tr>
<td>1-1/4 inches &lt; MR ≤ 2 inches</td>
<td>Type B</td>
</tr>
<tr>
<td>2 inches &lt; MR ≤ 4 inches</td>
<td>Joint Seal Assembly (Strip Seal)</td>
</tr>
<tr>
<td>MR &gt; 4 inches</td>
<td>Joint Seal Assembly (Modular Unit) or Seismic Joint</td>
</tr>
</tbody>
</table>

The first sentence of the eleventh paragraph of Section 51-1.12F(3)(b), "Type B Seal," of the Standard Specifications is amended to read:

- Samples of the prefabricated joint seals, not less than 3 feet in length, will be taken by the Engineer from each lot of material.

The fourth and fifth sentences of the sixth paragraph of Section 51-1.12H(1), "Plain and Fabric Reinforced Elastomeric Bearing Pads," of the Standard Specifications are amended to read:

- Each ply of fabric shall have a breaking strength of not less than 800 pounds per inch of width in each thread direction when 3" x 36" samples are tested on split drum grips. The bond between double plies shall have a minimum peel strength of 20 pounds per inch.

The hardness (Type A) requirement in the table in the eighth paragraph of Section 51-1.12H(1), "Plain and Fabric Reinforced Elastomeric Bearing Pads," of the Standard Specifications is amended to read:

| Hardness (Type A)     | D 2240 with 2kg mass. 55 ±5 |

The first sentence of subparagraph A of the first paragraph of Section 51-1.12H(2), "Steel
Reinforced Elastomeric Bearings," of the Standard Specifications is amended to read:

- The bearings shall consist of alternating steel laminates and internal elastomer laminates with top and bottom elastomer covers. Steel laminates shall have a nominal thickness of 0.075 inch (14 gage).

The first paragraph in Section 51-1.135, "Mortar," of the Standard Specifications is amended to read:

- Mortar shall be composed of cementitious material, sand, and water proportioned and mixed as specified in this Section 51-1.135.

The third paragraph in Section 51-1.135, "Mortar," of the Standard Specifications is amended to read:

- The proportion of cementitious material to sand, measured by volume, shall be one to 2 unless otherwise specified.

The third sentence of the fourth paragraph of Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications is amended to read:

- The surfaces shall have a profile trace showing no high points in excess of 0.25 inch, and the portions of the surfaces within the traveled way shall have a profile count of 5 or less in any 100-foot section.

**SECTION 55: STEEL STRUCTURES**

Issue Date: January 5, 2007

The CVN impact value for Grade HPS 50W in the table in the fifth paragraph of Section 55-2.01, "Description," of the Standard Specifications is amended to read:

<table>
<thead>
<tr>
<th>Grade HPS 50W* (4 inches and under in thickness)</th>
<th>20 at 10° F</th>
</tr>
</thead>
</table>

The first paragraph in Section 55-3.05, "Flatness of Faying and Bearing Surfaces," of the Standard Specifications is amended to read:

- Surfaces of bearing and base plates and other metal surfaces that are to come in contact with each other or with ground concrete surfaces or with asbestos sheet packing shall be flat to within 1/32-inch tolerance in 12 inches and to within 1/16-inch tolerance overall. Surfaces of bearing and base plates and other metal bearing surfaces that are to come in contact with

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Site Infrastructure Technical Specifications  
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preformed fabric pads, elastomeric bearing pads, or mortar shall be flat to within 1/8-inch tolerance in 12 inches and to within 3/16-inch tolerance overall.

Item B of the first paragraph of Section 55-3.10, "Fastener Threads," of the Standard Specifications is amended to read:

B. Internal threads shall conform to the requirements in ASTM Designation: A 563.

The third paragraph in Section 55-3.19, "Bearings and Anchorages," of the Standard Specifications is amended to read:

• Immediately before setting bearing assemblies or masonry plates directly on ground concrete surfaces, the Contractor shall thoroughly clean the surfaces of the concrete and the metal to be in contact and shall apply a coating of nonsag polysulfide or polyurethane caulkling conforming to the requirements in ASTM Designation: C 920 to contact areas to provide full bedding.

The fifth paragraph in Section 55-3.19, "Bearings and Anchorages," of the Standard Specifications is amended to read:

• Mortar to be placed below masonry plates or bearing plates of the bearing assemblies and in anchor bolt sleeves or canisters shall conform to the provisions in Section 51-1.135, "Mortar," except that the proportion of cementitious material to sand shall be 1:3.

Item D of the first paragraph of Section 55-4.01, "Measurement," of the Standard Specifications is amended to read:

D. To determine the pay quantities of galvanized metal, the weight to be added to the calculated weight of the base metal for the galvanizing will be determined from the table of weights of zinc coatings specified in ASTM Designation: A 153/A 153M.

SECTION 59: PAINTING

Issue Date: May 1, 2006

The third paragraph of Section 59-2.12, "Painting," of the Standard Specifications is amended to read:

• Contact surfaces of stiffeners, railings, built up members or open seam exceeding 6 mils in width that would retain moisture, shall be caulked with polysulfide or polyurethane sealing compound conforming to the requirements in ASTM Designation: C 920, Type S, Grade NS, Class 25, Use O, or other approved material.
The fourth paragraph of Section 59-2.12, "Painting," of the Standard Specifications is amended to read:

- The dry film thickness of the paint will be measured in place with a calibrated Type 2 magnetic film thickness gage in conformance with the requirements in SSPC-PA 2, "Measurement of Dry Coating Thickness with Magnetic Gages," of the "SSPC: The Society for Protective Coatings," except that there shall be no limit to the number or location of spot measurements to verify compliance with specified thickness requirements.

**SECTION 83: RAILINGS AND BARRIERS**

Issue Date: January 5, 2007

The seventh paragraph in Section 83-1.02, "Materials and Construction," of the Standard Specifications is amended to read:

- Mortar shall conform to the provisions in Section 51-1.135, "Mortar," and shall consist of one part by volume of cementitious material and 3 parts of clean sand.

Item b of the first paragraph in Section 83-2.02D(2), "Materials," of the Standard Specifications is amended to read:

b. If the 3/8-inch maximum size aggregate grading is used to construct extruded or slip-formed concrete barriers, the cementitious material content of the minor concrete shall be not less than 675 pounds per cubic yard.

The third paragraph in Section 83-2.02D(2), "Materials," of the Standard Specifications is amended to read:

- The concrete paving between the tops of the 2 walls of concrete barrier (Types 50E, 60E, 60GE, and 60SE) and the optional concrete slab at the base between the 2 walls of concrete barrier (Types 50E, 60E, 60GE, and 60SE) shall be constructed of minor concrete conforming to the provisions of Section 90-10, "Minor Concrete," except that the minor concrete shall contain not less than 505 pounds of cementitious material per cubic yard.

**SECTION 90: PORTLAND CEMENT CONCRETE**

Issue Date: January 5, 2007

Section 90, "Portland Cement Concrete," of the Standard Specifications is amended to read:
SECTION 90: PORTLAND CEMENT CONCRETE

90-1 GENERAL

90-1.01 DESCRIPTION
• Portland cement concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in these specifications.
• The Contractor shall determine the mix proportions for concrete in conformance with these specifications.
• Class 1 concrete shall contain not less than 675 pounds of cementitious material per cubic yard.
• Class 2 concrete shall contain not less than 590 pounds of cementitious material per cubic yard.
• Class 3 concrete shall contain not less than 505 pounds of cementitious material per cubic yard.
• Class 4 concrete shall contain not less than 420 pounds of cementitious material per cubic yard.
• Minor concrete shall contain not less than 550 pounds of cementitious material per cubic yard unless otherwise specified in these specifications or the technical specifications.
• Unless otherwise designated on the plans or specified in these specifications or the technical specifications, the amount of cementitious material used per cubic yard of concrete in structures or portions of structures shall conform to the following:

<table>
<thead>
<tr>
<th>Use</th>
<th>Cementitious Material Content (Pounds/CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete designated by compressive strength:</td>
<td></td>
</tr>
<tr>
<td>Deck slabs and slab spans of bridges</td>
<td>675 min., 800 max.</td>
</tr>
<tr>
<td>Roof sections of exposed top box culverts</td>
<td>675 min., 800 max.</td>
</tr>
<tr>
<td>Other portions of structures</td>
<td>590 min., 800 max.</td>
</tr>
<tr>
<td>Concrete not designated by compressive strength:</td>
<td></td>
</tr>
<tr>
<td>Deck slabs and slab spans of bridges</td>
<td>675 min.</td>
</tr>
<tr>
<td>Roof sections of exposed top box culverts</td>
<td>675 min.</td>
</tr>
<tr>
<td>Prestressed members</td>
<td>675 min.</td>
</tr>
<tr>
<td>Seal courses</td>
<td>675 min.</td>
</tr>
<tr>
<td>Other portions of structures</td>
<td>590 min.</td>
</tr>
<tr>
<td>Concrete for precast members</td>
<td>590 min., 925 max.</td>
</tr>
</tbody>
</table>

• Whenever the 28-day compressive strength shown on the plans is greater than 3,600 pounds per square inch, the concrete shall be designated by compressive strength. If the plans show a 28-day compressive strength that is 4,000 pounds per square inch or greater, an additional 14 days will be allowed to obtain the specified strength. The 28-day compressive strengths shown on the plans that are 3,600 pounds per square inch or less are shown for design information only and are not a requirement for acceptance of the concrete.
• Concrete designated by compressive strength shall be proportioned such that the concrete will attain the strength shown on the plans or specified in the technical specifications.
Before using concrete for which the mix proportions have been determined by the Contractor, or in advance of revising those mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design.

Compliance with cementitious material content requirements will be verified in conformance with procedures described in California Test 518 for cement content. For testing purposes, supplementary cementitious material shall be considered to be cement. Batch proportions shall be adjusted as necessary to produce concrete having the specified cementitious material content.

If any concrete has a cementitious material, portland cement, or supplementary cementitious material content that is less than the minimum required, the concrete shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place and the Contractor shall pay to the State $0.25 for each pound of cementitious material, portland cement, or supplementary cementitious material that is less than the minimum required. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract. The deductions will not be made unless the difference between the contents required and those actually provided exceeds the batching tolerances permitted by Section 90-5, "Proportioning." No deductions will be made based on the results of California Test 518.

The requirements of the preceding paragraph shall not apply to minor concrete or commercial quality concrete.

90-2 MATERIALS

90-2.01 CEMENTITIOUS MATERIALS

Unless otherwise specified, cementitious material shall be either a combination of Type II or Type V portland cement and a supplementary cementitious material, or a blended cement.

Cementitious materials used in cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same sources and of the same proportions.

Cementitious materials shall be protected from moisture until used. Sacked cementitious materials shall be piled to permit access for tallying, inspecting, and identifying each shipment.

Facilities shall be provided to ensure that cementitious materials meeting this Section 90-2.01 are kept separate from other cementitious materials. Sampling cementitious materials shall be in conformance with California Test 125.

The Contractor shall furnish a Certificate of Compliance for cementious materials in conformance with the provisions in Section 6-1.07, "Certificates of Compliance." The Certificate of Compliance shall indicate the source by name and location (including country, state, and city). If cementitious material is delivered directly to the job site, the Certificate of Compliance shall be signed by the cementitious material supplier. If the cementitious material is used in ready-mixed concrete or in precast concrete products purchased as such by the Contractor, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product.
90-2.01A CEMENT

- Portland cement shall conform to the requirements in ASTM Designation: C 150 except, using a 10-sample moving average, limestone shall not exceed 2.5 percent. The C₃S content of Type II cement shall not exceed 65 percent.
- Blended cement shall conform to the requirements for Portland Blast-Furnace Slag, Cement Type IS (MS) or Portland-Pozzolan Cement, Type IP (MS) in AASHTO Designation: M 240 and shall be comprised of an intimate and uniform blend of Type II or Type V cement and supplementary cementitious material in an amount conforming to the requirements in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials."
- In addition, blended cement, Type II portland cement, and Type V portland cement shall conform to the following requirements:
  
  A. The cement shall not contain more than 0.60-percent by mass of alkalies, calculated as the percentage of Na₂O plus 0.658 times the percentage of K₂O, when determined by methods as required in AASHTO Designation: T 105;
  B. The autoclave expansion shall not exceed 0.50-percent; and
  C. Mortar, containing the cement to be used and Ottawa sand, when tested in conformance with California Test 527, shall not expand in water more than 0.010-percent and shall not contract in air more than 0.048-percent, except that when cement is to be used for precast prestressed concrete piling, precast prestressed concrete members, or steam cured concrete products, the mortar shall not contract in air more than 0.053-percent.

- Type III portland cement shall be used only as specified in the technical specifications or with the approval of the Engineer. Type III portland cement shall conform to the additional requirements listed above for Type II portland cement, except when tested in conformance with California Test 527, mortar containing Type III portland cement shall not contract in air more than 0.075-percent.

90-2.01B SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM)

- Fly ash shall conform to the requirements in AASHTO Designation: M 295, Class F, and the following:
  
  A. Calcium oxide content shall not exceed 10 percent.
  B. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.
  C. Commingling of fly ash from different sources at uncontrolled ratios is permissible only if the following criteria are satisfied:

  1. Sources of fly ash to be commingled shall be on the approved list of materials for use in concrete.
  2. Testing of the commingled product is the responsibility of the fly ash supplier.
3. Each fly ash's running average of density shall not differ from any other by more than 0.01-pound per cubic inch at the time of commingling.
4. Each fly ash's running average of loss on ignition shall not differ from any other by more than one percent at the time of commingling.
5. The final product of commingled fly ash shall conform to the requirement in AASHTO Designation: M 295.

- Raw or calcined natural pozzolans shall conform to the requirements in AASHTO Designation: M 295, Class N and the following requirements:
  A. Calcium oxide content shall not exceed 10 percent.
  B. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.

- Ground Granulated Blast Furnace Slag (GGBFS) shall conform to the requirements in AASHTO Designation: M 302, Grade 100 or Grade 120.
- Silica Fume shall conform to the requirements of AASHTO Designation: M 307, with reduction in mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.

90-2.01C REQUIRED USE OF SUPPLEMENTARY CEMENTITIOUS MATERIALS

- The amount of portland cement and SCM used in portland cement concrete shall conform to the minimum cementitious material content provisions in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," and the following:
  A. If a blended cement conforming to the provisions in Section 90-2.01A, "Cement," is used, the minimum amount of SCM incorporated into the cement shall conform to the provisions in this Section 90-2.01C.
  B. Fly ash or natural pozzolan, silica fume, or GGBFS shall not be used with Type IP or Type IS cements.

- Use of SCMs shall conform to the following:
  A. If fly ash or natural pozzolan is used:
    1. The minimum amount of portland cement shall not be less than 75 percent by weight of the specified minimum cementitious material content.
    2. The minimum amount of fly ash or natural pozzolan shall be:
       a. Fifteen percent by weight of the total amount of cementitious material if the calcium oxide content of fly ash or natural pozzolan is equal to or less than

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2 percent by weight;
b. Twenty-five percent by weight of the total amount of cementitious material if the calcium oxide content of fly ash or natural pozzolan is greater than 2 percent by weight.

3. The total amount of fly ash or natural pozzolan shall not exceed 35 percent by weight of the total amount of cementitious material to be used in the mix. If Section 90-1.01, "Description," specifies a maximum cementitious material content in pounds per cubic yard, the total weight of portland cement and fly ash or natural pozzolan per cubic yard shall not exceed the specified maximum cementitious material content.

B. If silica fume is used:

1. The amount of silica fume shall not be less than 10 percent by weight of the total amount of cementitious material.
2. The amount of portland cement shall not be less than 75 percent by weight of the specified minimum cementitious material content.
3. If Section 90-1.01, "Description," specifies a maximum cementitious material content in pounds per cubic yard, the total weight of portland cement and silica fume per cubic yard shall not exceed the specified maximum cementitious material content.

C. If GGBFS is used:

1. The minimum amount of GGBFS shall be either:
   a. Forty percent of the total cementitious material to be used, if the aggregates used in the concrete are on the Department's list of "Approved Aggregates For Use in Concrete with Reduced Fly Ash."
   b. No less than 50 percent.
2. The amount of GGBFS shall not exceed 60 percent by weight of the total amount of cementitious materials to be used.

90-2.02 AGGREGATES

- Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.
- The Contractor shall provide safe and suitable facilities, including necessary splitting devices for obtaining samples of aggregates, in conformance with California Test 125.
- Aggregates shall be of such character that it will be possible to produce workable concrete within the limits of water content provided in Section 90-6.06, "Amount of Water and Penetration."
- Aggregates shall have not more than 10 percent loss when tested for soundness in
conformance with the requirements in California Test 214. The soundness requirement for fine aggregate will be waived, provided that the durability index, \( D_f \), of the fine aggregate is 60 or greater when tested for durability in conformance with California Test 229.

- If the results of any one or more of the Cleanness Value, Sand Equivalent, or aggregate grading tests do not meet the requirements specified for "Operating Range" but all meet the "Contract Compliance" requirements, the placement of concrete shall be suspended at the completion of the current pour until tests or other information indicate that the next material to be used in the work will comply with the requirements specified for "Operating Range."
- If the results of either or both the Cleanness Value and coarse aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete that is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $3.50 per cubic yard for paving concrete and $5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.
- If the results of either or both the Sand Equivalent and fine aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete which is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $3.50 per cubic yard for paving concrete and $5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

The 2 preceding paragraphs apply individually to the "Contract Compliance" requirements for coarse aggregate and fine aggregate. When both coarse aggregate and fine aggregate do not conform to the "Contract Compliance" requirements, both paragraphs shall apply. The payments specified in those paragraphs are in addition to any payments made in conformance with the provisions in Section 90-1.01, "Description."

- No single Cleanness Value, Sand Equivalent, or aggregate grading test shall represent more than 300 cubic yards of concrete or one day's pour, whichever is smaller.
- When the source of an aggregate is changed, the Contractor shall adjust the mix proportions and submit in writing to the Engineer a copy of the mix design before using the aggregates.

90-2.02A  COARSE AGGREGATE

- Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, reclaimed aggregate, crushed air-cooled iron blast furnace slag or combinations thereof. Crushed air-cooled blast furnace slag shall not be used in reinforced or prestressed concrete.
- Reclaimed aggregate is aggregate that has been recovered from plastic concrete by washing away the cementitious material. Reclaimed aggregate shall conform to all aggregate requirements.
- Coarse aggregate shall conform to the following quality requirements:
Tests of California Test Requirements

| Loss in Los Angeles Rattler (after 500 revolutions) | 211 | 45% max. |
| Cleanness Value | Operating Range | 227 | 75 min. |
| Cleanness Value | Contract Compliance | 227 | 71 min. |

- In lieu of the above Cleanness Value requirements, a Cleanness Value "Operating Range" limit of 71, minimum, and a Cleanness Value "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the coarse aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

  A. Coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested in conformance with the requirements in California Test 227; and
  B. Prequalification tests performed in conformance with the requirements in California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

**90-2.02B FINE AGGREGATE**

- Fine aggregate shall consist of natural sand, manufactured sand produced from larger aggregate or a combination thereof. Manufactured sand shall be well graded.
- Fine aggregate shall conform to the following quality requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>California Test</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Impurities</td>
<td>213</td>
<td>Satisfactory*</td>
</tr>
<tr>
<td>Mortar Strengths Relative to Ottawa Sand</td>
<td>515</td>
<td>95%, min.</td>
</tr>
<tr>
<td>Sand Equivalent:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Range</td>
<td>217</td>
<td>75, min.</td>
</tr>
<tr>
<td>Contract Compliance</td>
<td>217</td>
<td>71, min.</td>
</tr>
</tbody>
</table>

*Fine aggregate developing a color darker than the reference standard color solution may be accepted if it is determined by the Engineer, from mortar strength tests, that a darker color is acceptable.

- In lieu of the above Sand Equivalent requirements, a Sand Equivalent "Operating Range" limit of 71, minimum, and a Sand Equivalent "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the fine aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:
A. Fine aggregate sampled at the completion of processing at the aggregate production plant had a Sand Equivalent value of not less than 82 when tested by California Test 217; and
B. Prequalification tests performed in conformance with California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.03 WATER

- In conventionally reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 1,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO_4, when tested in conformance with California Test 417. In prestressed concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 650 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO_4, when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either: 1) a change in the setting time of cement of more than 25 percent when tested in conformance with the requirements in ASTM Designation: C 191 or ASTM Designation: C 266 or 2) a reduction in the compressive strength of mortar at 14 days of more than 5 percent, when tested in conformance with the requirements in ASTM Designation: C 109, when compared to the results obtained with distilled water or deionized water, tested in conformance with the requirements in ASTM Designation: C 109.
- In nonreinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1,500 parts per million of sulfates as SO_4, when tested in conformance with California Test 417.
- In addition to the above provisions, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of the concrete or produce etching of the surface.
- Water reclaimed from mixer wash-out operations may be used in mixing concrete. The water shall not contain coloring agents or more than 300 parts per million of alkalis (Na_2O + 0.658 K_2O) as determined on the filtrate. The specific gravity of the water shall not exceed 1.03 and shall not vary more than ±0.010 during a day's operations.

90-2.04 ADMIXTURE MATERIALS

- Admixture materials shall conform to the requirements in the following ASTM Designations:

  A. Chemical Admixtures—ASTM Designation: C 494.

90-3 AGGREGATE GRADINGS

90-3.01 GENERAL

- Before beginning concrete work, the Contractor shall submit in writing to the Engineer
the gradation of the primary aggregate nominal sizes that the Contractor proposes to furnish. If a primary coarse aggregate or the fine aggregate is separated into 2 or more sizes, the proposed gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically to indicate one proposed gradation. The proposed gradation shall meet the grading requirements shown in the table in this section, and shall show the percentage passing each of the sieve sizes used in determining the end result.

- The Engineer may waive, in writing, the gradation requirements in this Section 90-3.01 and in Sections 90-3.02, "Coarse Aggregate Grading," 90-3.03, "Fine Aggregate Grading," and 90-3.04, "Combined Aggregate Gradings," if, in the Engineer's opinion, furnishing the gradation is not necessary for the type or amount of concrete work to be constructed.

- Gradations proposed by the Contractor shall be within the following percentage passing limits:

<table>
<thead>
<tr>
<th>Primary Aggregate Nominal Size</th>
<th>Sieve Size</th>
<th>Limits of Proposed Gradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot; x 3/4&quot;</td>
<td>1&quot;</td>
<td>19 - 41</td>
</tr>
<tr>
<td>1&quot; x No. 4</td>
<td>3/4&quot;</td>
<td>52 - 85</td>
</tr>
<tr>
<td>1&quot; x No. 4</td>
<td>3/8&quot;</td>
<td>15 - 38</td>
</tr>
<tr>
<td>1/2&quot; x No. 4</td>
<td>3/8&quot;</td>
<td>40 - 78</td>
</tr>
<tr>
<td>3/8&quot; x No. 8</td>
<td>3/8&quot;</td>
<td>50 - 85</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>No. 16</td>
<td>55 - 75</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>No. 30</td>
<td>34 - 46</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>No. 50</td>
<td>16 - 29</td>
</tr>
</tbody>
</table>

- Should the Contractor change the source of supply, the Contractor shall submit in writing to the Engineer the new gradations before their intended use.

90-3.02 COARSE AGGREGATE GRADING

- The grading requirements for coarse aggregates are shown in the following table for each size of coarse aggregate:

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>1 1/2&quot; x 3/4&quot;</th>
<th>1&quot; x No. 4</th>
<th>1/2&quot; x No. 4</th>
<th>3/8&quot; x No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
<td>100</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>88 - 100</td>
<td>85 - 100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>X ±18</td>
<td>X ±25</td>
<td>88 - 100</td>
<td>86 - 100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>0 - 17</td>
<td>0 - 20</td>
<td>X ±15</td>
<td>X ±22</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>0 - 7</td>
<td>0 - 9</td>
<td>X ±15</td>
<td>X ±22</td>
</tr>
<tr>
<td>No. 4</td>
<td>—</td>
<td>—</td>
<td>0 - 16</td>
<td>0 - 18</td>
</tr>
<tr>
<td>No. 8</td>
<td>—</td>
<td>—</td>
<td>0 - 6</td>
<td>0 - 7</td>
</tr>
</tbody>
</table>

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In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

Coarse aggregate for the 1 1/2 inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," shall be furnished in 2 or more primary aggregate nominal sizes. Each primary aggregate nominal size may be separated into 2 sizes and stored separately, provided that the combined material conforms to the grading requirements for that particular primary aggregate nominal size.

When the one inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," is to be used, the coarse aggregate may be separated into 2 sizes and stored separately, provided that the combined material shall conform to the grading requirements for the 1" x No. 4 primary aggregate nominal size.

90-3.03 FINE AGGREGATE GRADING

Fine aggregate shall be graded within the following limits:

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>Percentage Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operating Range</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>65 - 95</td>
</tr>
<tr>
<td>No. 16</td>
<td>X ±10</td>
</tr>
<tr>
<td>No. 30</td>
<td>X ±9</td>
</tr>
<tr>
<td>No. 50</td>
<td>X ±6</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 - 12</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 8</td>
</tr>
</tbody>
</table>

In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."

In addition to the above required grading analysis, the distribution of the fine aggregate sizes shall be such that the difference between the total percentage passing the No. 16 sieve and the total percentage passing the No. 30 sieve shall be between 10 and 40, and the difference between the percentage passing the No. 30 sieve and No. 50 sieves shall be between 10 and 40.

Fine aggregate may be separated into 2 or more sizes and stored separately, provided that the combined material conforms to the grading requirements specified in this Section 90-3.03.

90-3.04 COMBINED AGGREGATE GRADINGS

Combined aggregate grading limits shall be used only for the design of concrete mixes. Concrete mixes shall be designed so that aggregates are combined in proportions that shall produce a mixture within the grading limits for combined aggregates as specified herein.

The combined aggregate grading, except when otherwise specified in these specifications or the technical specifications, shall be either the 1 1/2 inch, maximum grading, or the 1 inch, maximum grading, at the option of the Contractor.
### Grading Limits of Combined Aggregates

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>1 1/2&quot; Max.</th>
<th>1&quot; Max.</th>
<th>1/2&quot; Max.</th>
<th>3/8&quot; Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>90 - 100</td>
<td>100</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1&quot;</td>
<td>50 - 86</td>
<td>90 - 100</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>45 - 75</td>
<td>55 - 100</td>
<td>100</td>
<td>—</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>—</td>
<td>—</td>
<td>90 - 100</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>38 - 55</td>
<td>45 - 75</td>
<td>55 - 86</td>
<td>50 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>30 - 45</td>
<td>35 - 60</td>
<td>45 - 63</td>
<td>45 - 63</td>
</tr>
<tr>
<td>No. 8</td>
<td>23 - 38</td>
<td>27 - 45</td>
<td>35 - 49</td>
<td>35 - 49</td>
</tr>
<tr>
<td>No. 16</td>
<td>17 - 33</td>
<td>20 - 35</td>
<td>25 - 37</td>
<td>25 - 37</td>
</tr>
<tr>
<td>No. 30</td>
<td>10 - 22</td>
<td>12 - 25</td>
<td>15 - 25</td>
<td>15 - 25</td>
</tr>
<tr>
<td>No. 50</td>
<td>4 - 10</td>
<td>5 - 15</td>
<td>5 - 15</td>
<td>5 - 15</td>
</tr>
<tr>
<td>No. 100</td>
<td>1 - 6</td>
<td>1 - 8</td>
<td>1 - 8</td>
<td>1 - 8</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 3</td>
<td>0 - 4</td>
<td>0 - 4</td>
<td>0 - 4</td>
</tr>
</tbody>
</table>

- Changes from one grading to another shall not be made during the progress of the work unless permitted by the Engineer.

### 90-4 ADMIXTURES

#### 90-4.01 GENERAL
- Admixtures used in portland cement concrete shall conform to and be used in conformance with the provisions in this Section 90-4 and the technical specifications. Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option as provided herein.
- Chemical admixtures and air-entraining admixtures containing chlorides as Cl in excess of one percent by weight of admixture, as determined by California Test 415, shall not be used.
- Admixtures shall be uniform in properties throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.
- If more than one admixture is used, the admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.
- Chemical admixtures shall be used in conformance with the manufacturer's written recommendations.

#### 90-4.02 MATERIALS
- Admixture materials shall conform to the provisions in Section 90–2.04, "Admixture Materials."

#### 90-4.03 ADMIXTURE APPROVAL
- No admixture brand shall be used in the work unless it is on the Department's current list of approved brands for the type of admixture involved.
- Admixtures will be considered for addition to the approved list if the manufacturer of the admixture submits to the Transportation Laboratory a sample of the admixture
accompanied by certified test results demonstrating that the admixture complies with the requirements in the appropriate ASTM Designation and these specifications. The sample shall be sufficient to permit performance of all required tests. Approval of admixture brands will be dependent upon a determination as to compliance with the requirements, based on the certified test results submitted, together with tests the Department may elect to perform.

- If the Contractor proposes to use an admixture of a brand and type on the current list of approved admixture brands, the Contractor shall furnish a Certificate of Compliance from the manufacturer, as provided in Section 6-1.07, "Certificates of Compliance," certifying that the admixture furnished is the same as that previously approved. If a previously approved admixture is not accompanied by a Certificate of Compliance, the admixture shall not be used in the work until the Engineer has had sufficient time to make the appropriate tests and has approved the admixture for use. The Engineer may take samples for testing at any time, whether or not the admixture has been accompanied by a Certificate of Compliance.

90-4.04 REQUIRED USE OF CHEMICAL ADMIXTURES
- If the use of a chemical admixture is specified, the admixture shall be used at the dosage specified, except that if no dosage is specified, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

90-4.05 OPTIONAL USE OF CHEMICAL ADMIXTURES
- The Contractor may use Type A or F, water-reducing; Type B, retarding; or Type D or G, water-reducing and retarding admixtures as described in ASTM Designation: C 494 to conserve cementitious material or to facilitate any concrete construction application subject to the following conditions:
  A. If a water-reducing admixture or a water-reducing and retarding admixture is used, the cementitious material content specified or ordered may be reduced by a maximum of 5 percent by weight, except that the resultant cementitious material content shall be not less than 505 pounds per cubic yard; and
  B. When a reduction in cementitious material content is made, the dosage of admixture used shall be the dosage used in determining approval of the admixture.

- Unless otherwise specified, a Type C accelerating chemical admixture conforming to the requirements in ASTM Designation: C 494, may be used in portland cement concrete. Inclusion in the mix design submitted for approval will not be required provided that the admixture is added to counteract changing conditions that contribute to delayed setting of the portland cement concrete, and the use or change in dosage of the admixture is approved in writing by the Engineer.

90-4.06 REQUIRED USE OF AIR-ENTRAINING ADMIXTURES
- When air-entrainment is specified or ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce a concrete having the specified air content as determined by California Test 504.
90-4.07 OPTIONAL USE OF AIR-ENTRAINING ADMIXTURES
• When air-entrainment has not been specified or ordered by the Engineer, the Contractor will be permitted to use an air-entraining admixture to facilitate the use of any construction procedure or equipment provided that the average air content, as determined by California Test 504, of 3 successive tests does not exceed 4 percent, and no single test value exceeds 5.5 percent. If the Contractor elects to use an air-entraining admixture in concrete for pavement, the Contractor shall so indicate at the time the Contractor designates the source of aggregate.

90-4.08 BLANK

90-4.09 BLANK

90-4.10 PROPORTIONING AND DISPENSING LIQUID ADMIXTURES
• Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers for liquid admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within ±5 percent of the prescribed quantity for each batch. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each measuring unit shall be clearly marked for the type and quantity of admixture.
• Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn slowly by the Engineer.
• If more than one liquid admixture is used in the concrete mix, each liquid admixture shall have a separate measuring unit and shall be dispensed by injecting equipment located in such a manner that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other. When air-entraining admixtures are used in conjunction with other liquid admixtures, the air-entraining admixture shall be the first to be incorporated into the mix, unless it is demonstrated that a different sequence improves performance.
• When automatic proportioning devices are required for concrete pavement, dispensers for liquid admixtures shall operate automatically with the batching control equipment. The dispensers shall be equipped with an automatic warning system in good operating condition that will provide a visible or audible signal at the point at which proportioning operations are controlled when the quantity of admixture measured for each batch of concrete varies from the preselected dosage by more than 5 percent, or when the entire contents of the measuring unit are not emptied from the dispenser into each batch of concrete.
• Unless liquid admixtures are added to premeasured water for the batch, their discharge into the batch shall be arranged to flow into the stream of water so that the admixtures are well dispersed throughout the batch, except that air-entraining admixtures may be dispensed directly into moist sand in the batching bins provided that adequate control of the air content of the concrete can be maintained.
• Liquid admixtures requiring dosages greater than one-half gallon per cubic yard shall be considered to be water when determining the total amount of free water as specified in Section 90-6.06, "Amount of Water and Penetration."

90-4.11 BLANK

90-5 PROPORTIONING

90-5.01 STORAGE OF AGGREGATES
• Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size shall be avoided and the various sizes shall not become intermixed before proportioning.
• Aggregates shall be stored or stockpiled and handled in a manner that prevent contamination by foreign materials. In addition, storage of aggregates at batching or mixing facilities that are erected subsequent to the award of the contract and that furnish concrete to the project shall conform to the following:
  A. Intermingling of the different sizes of aggregates shall be positively prevented. The Contractor shall take the necessary measures to prevent intermingling. The preventive measures may include, but are not necessarily limited to, physical separation of stockpiles or construction of bulkheads of adequate length and height; and
  B. Contamination of aggregates by contact with the ground shall be positively prevented. The Contractor shall take the necessary measures to prevent contamination. The preventive measures shall include, but are not necessarily limited to, placing aggregates on wooden platforms or on hardened surfaces consisting of portland cement concrete, asphalt concrete, or cement treated material.

• In placing aggregates in storage or in moving the aggregates from storage to the weigh hopper of the batching plant, any method that may cause segregation, degradation, or the combining of materials of different gradings that will result in any size of aggregate at the weigh hopper failing to meet the grading requirements, shall be discontinued. Any method of handling aggregates that results in excessive breakage of particles shall be discontinued. The use of suitable devices to reduce impact of falling aggregates may be required by the Engineer.

90-5.02 PROPORTIONING DEVICES
• Weighing, measuring, or metering devices used for proportioning materials shall conform to the requirements in Section 9-1.01, "Measurement of Quantities," and this Section 90-5.02. In addition, automatic weighing systems shall comply with the requirements for automatic proportioning devices in Section 90-5.03A, "Proportioning for Pavement." Automatic devices shall be automatic to the extent that the only manual operation required for proportioning the aggregates, cement, and supplementary cementitious material for one batch of concrete is a single operation of a switch or starter.
• Proportioning devices shall be tested as frequently as the Engineer may deem necessary to ensure their accuracy.
• Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the plant is in operation, the weight of each batch of material shall not vary from the weight designated by the Engineer by more than the tolerances specified herein.

• Equipment for cumulative weighing of aggregate shall have a zero tolerance of ±0.5 percent of the designated total batch weight of the aggregate. For systems with individual weigh hoppers for the various sizes of aggregate, the zero tolerance shall be ±0.5 percent of the individual batch weight designated for each size of aggregate. Equipment for cumulative weighing of cement and supplementary cementitious material shall have a zero tolerance of ±0.5 percent of the designated total batch weight of the cement and supplementary cementitious material. Equipment for weighing cement or supplementary cementitious material separately shall have a zero tolerance of ±0.5 percent of their designated individual batch weights. Equipment for measuring water shall have a zero tolerance of ±0.5 percent of its designated weight or volume.

• The weight indicated for any batch of material shall not vary from the preselected scale setting by more than the following:

A. Aggregate weighed cumulatively shall be within 1.0 percent of the designated total batch weight of the aggregate. Aggregates weighed individually shall be within 1.5 percent of their respective designated batch weights; and

B. Cement shall be 99 to 102 percent of its designated batch weight. When weighed individually, supplementary cementitious material shall be 99 to 102 percent of its designated batch weight. When supplementary cementitious material and cement are permitted to be weighed cumulatively, cement shall be weighed first to 99 to 102 percent of its designated batch weight, and the total for cement and supplementary cementitious material shall be 99 to 102 percent of the sum of their designated batch weights; and

C. Water shall be within 1.5 percent of its designated weight or volume.

• Each scale graduation shall be approximately 0.001 of the total capacity of the scale. The capacity of scales for weighing cement, supplementary cementitious material, or cement plus supplementary cementitious material and aggregates shall not exceed that of commercially available scales having single graduations indicating a weight not exceeding the maximum permissible weight variation above, except that no scale shall be required having a capacity of less than 1,000 pounds, with one pound graduations.

90-5.03 PROPORTIONING

• Proportioning shall consist of dividing the aggregates into the specified sizes, each stored in a separate bin, and combining them with cementitious material and water as provided in these specifications. Aggregates shall be proportioned by weight.

• At the time of batching, aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing. In no event shall the free moisture content of the fine aggregate at the time of batching exceed 8 percent of its

Soldier Pile Wall
Site Infrastructure Technical Specifications
Dry Creek Rancheria Band of Pomo Indians

June 2, 2008
Section 02487-28
• Should separate supplies of aggregate material of the same size group, but of different
moisture content or specific gravity or surface characteristics affecting workability, be available
at the proportioning plant, withdrawals shall be made from one supply exclusively and the
materials therein completely exhausted before starting upon another.
• Bulk Type IP (MS) cement shall be weighed in an individual hopper and shall be kept
separate from the aggregates until the ingredients are released for discharge into the mixer.
• Bulk cement and supplementary cementitious material may be weighed in separate,
individual weigh hoppers or may be weighed in the same weigh hopper and shall be kept
separate from the aggregates until the ingredients are released for discharge into the mixer. If
the cement and supplementary cementitious material are weighed cumulatively, the cement shall
be weighed first.
• If cement and supplementary cementitious material are weighed in separate weigh
hoppers, the weigh systems for the proportioning of the aggregate, the cement, and the
supplementary cementitious material shall be individual and distinct from all other weigh
systems. Each weigh system shall be equipped with a hopper, a lever system, and an indicator to
constitute an individual and independent material-weighing device. The cement and the
supplementary cementitious material shall be discharged into the mixer simultaneously with the
aggregate.
• The scales and weigh hoppers for bulk weighing cement, supplementary cementitious
material, or cement plus supplementary cementitious material shall be separate and distinct from
the aggregate weighing equipment.
• For batches of one cubic yard or more, the batching equipment shall conform to one of
the following combinations:

A. Separate boxes and separate scale and indicator for weighing each size of aggregate.
B. Single box and scale indicator for all aggregates.
C. Single box or separate boxes and automatic weighing mechanism for all aggregates.

• In order to check the accuracy of batch weights, the gross weight and tare weight of batch
trucks, truck mixers, truck agitators, and non-agitating hauling equipment shall be determined
when ordered by the Engineer. The equipment shall be weighed on scales designated by the
Engineer.

90-6 MIXING AND TRANSPORTING

90-6.01 GENERAL

• Concrete shall be mixed in mechanically operated mixers, except that when permitted by
the Engineer, batches not exceeding 1/3 cubic yard may be mixed by hand methods in
conformance with the provisions in Section 90-6.05, "Hand-Mixing."
• Equipment having components made of aluminum or magnesium alloys that would have
contact with plastic concrete during mixing, transporting, or pumping of portland cement
concrete shall not be used.
• Concrete shall be homogeneous and thoroughly mixed, and there shall be no lumps or
• Uniformity of concrete mixtures will be determined by differences in penetration as determined by California Test 533, or slump as determined by ASTM Designation: C 143, and by variations in the proportion of coarse aggregate as determined by California Test 529.
• When the mix design specifies a penetration value, the difference in penetration, determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed 1/2-inch. When the mix design specifies a slump value, the difference in slump, determined by comparing slump tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed the values given in the table below. Variation in the proportion of coarse aggregate will be determined by comparing the results of tests of 2 samples of mixed concrete from the same batch or truck mixer load and the difference between the 2 results shall not exceed 170 pounds per cubic yard of concrete.

<table>
<thead>
<tr>
<th>Average Slump</th>
<th>Maximum Permissible Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>4&quot; to 6&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>Greater than 6&quot; to 9&quot;</td>
<td>2&quot;</td>
</tr>
</tbody>
</table>

• The Contractor shall furnish samples of the freshly mixed concrete and provide satisfactory facilities for obtaining the samples.

90-6.02 MACHINE MIXING
• Concrete mixers may be of the revolving drum or the revolving blade type, and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. Mixers and agitators that have an accumulation of hard concrete or mortar shall not be used.
• The temperature of mixed concrete, immediately before placing, shall be not less than 50° F or more than 90° F. Aggregates and water shall be heated or cooled as necessary to produce concrete within these temperature limits. Neither aggregates nor mixing water shall be heated to exceed 150° F. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.
• The batch shall be so charged into the mixer that some water will enter in advance of cementitious materials and aggregates. All water shall be in the drum by the end of the first one-fourth of the specified mixing time.
• Cementitious materials shall be batched and charged into the mixer by means that will not result either in loss of cementitious materials due to the effect of wind, in accumulation of cementitious materials on surfaces of conveyors or hoppers, or in other conditions that reduce or vary the required quantity of cementitious material in the concrete mixture.
• Paving and stationary mixers shall be operated with an automatic timing device. The timing device and discharge mechanism shall be interlocked so that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.
• The total elapsed time between the intermingling of damp aggregates and all cementitious materials and the start of mixing shall not exceed 30 minutes.
• The size of batch shall not exceed the manufacturer's guaranteed capacity.
• When producing concrete for pavement or base, suitable batch counters shall be installed and maintained in good operating condition at job site batching plants and stationary mixers. The batch counters shall indicate the exact number of batches proportioned and mixed.
• Concrete shall be mixed and delivered to the job site by means of one of the following combinations of operations:

A. Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in nonagitating hauling equipment (central-mixed concrete).
B. Mixed partially in a stationary mixer, and the mixing completed in a truck mixer (shrink-mixed concrete).
C. Mixed completely in a truck mixer (transit-mixed concrete).
D. Mixed completely in a paving mixer.

• Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.
• Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified.
• When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed will be allowed for partial mixing in a central plant.

90-6.03 TRANSPORTING MIXED CONCRETE

• Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place, and provided the mixed concrete after hauling to the delivery point conforms to the provisions in Section 90-6.01, "General."
• Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity and shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.
• Bodies of nonagitating hauling equipment shall be constructed so that leakage of the concrete mix, or any part thereof, will not occur at any time.
• Concrete hauled in open-top vehicles shall be protected during hauling against rain or against exposure to the sun for more than 20 minutes when the ambient temperature exceeds 75° F.
• No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point, unless authorized by the Engineer. If the Engineer authorizes
additional water to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.

- The rate of discharge of mixed concrete from truck mixer-agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.
- If a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1.5 hours or before 250 revolutions of the drum or blades, whichever occurs first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or if the temperature of the concrete is 85°F or above, the time allowed may be less than 1.5 hours. If an admixture is used to retard the set time, the temperature of the concrete shall not exceed 85°F, the time limit shall be 2 hours, and the revolution limitation shall be 300.
- If nonagitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85°F or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.
- Each load of concrete delivered at the job site shall be accompanied by a weighmaster certificate showing the mix identification number, nonrepeating load number, date and time at which the materials were batched, the total amount of water added to the load, and for transit-mixed concrete, the reading of the revolution counter at the time the truck mixer is charged with cement. This weighmaster certificate shall also show the actual scale weights (pounds) for the ingredients batched. Theoretical or target batch weights shall not be used as a substitute for actual scale weights.
- Weighmaster certificates shall be provided in printed form, or if approved by the Engineer, the data may be submitted in electronic media. Electronic media shall be presented in a tab-delimited format on a 3 1/2-inch diskette with a capacity of at least 1.4 megabytes. Captured data, for the ingredients represented by each batch shall be "line feed, carriage return" (LFCR) and "one line, separate record" with allowances for sufficient fields to satisfy the amount of data required by these specifications.
- The Contractor may furnish a weighmaster certificate accompanied by a separate certificate that lists the actual batch weights or measurements for a load of concrete provided that both certificates are imprinted with the same nonrepeating load number that is unique to the contract and delivered to the jobsite with the load.
- Weighmaster certificates furnished by the Contractor shall conform to the provisions in Section 9-1.01, "Measurement of Quantities."

90-6.04 TIME OR AMOUNT OF MIXING

- Mixing of concrete in paving or stationary mixers shall continue for the required mixing time after all ingredients, except water and admixture, if added with the water, are in the mixing compartment of the mixer before any part of the batch is released. Transfer time in multiple drum mixers shall not be counted as part of the required mixing time.
- The required mixing time, in paving or stationary mixers, of concrete used for concrete structures, except minor structures, shall be not less than 90 seconds or more than 5 minutes,
except that when directed by the Engineer in writing, the requirements of the following paragraph shall apply.

• The required mixing time, in paving or stationary mixers, except as provided in the preceding paragraph, shall be not less than 50 seconds or more than 5 minutes.

• The minimum required revolutions at the mixing speed for transit-mixed concrete shall not be less than that recommended by the mixer manufacturer, but in no case shall the number of revolutions be less than that required to consistently produce concrete conforming to the provisions for uniformity in Section 90-6.01, "General."

• When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

90-6.05 HAND-MIXING

• Hand-mixed concrete shall be made in batches of not more than 1/3 cubic yard and shall be mixed on a watertight, level platform. The proper amount of coarse aggregate shall be measured in measuring boxes and spread on the platform and the fine aggregate shall be spread on this layer, the 2 layers being not more than one foot in total depth. On this mixture shall be spread the dry cementitious materials and the whole mass turned no fewer than 2 times dry; then sufficient clean water shall be added, evenly distributed, and the whole mass again turned no fewer than 3 times, not including placing in the carriers or forms.

90-6.06 AMOUNT OF WATER AND PENETRATION

• The amount of water used in concrete mixes shall be regulated so that the penetration of the concrete as determined by California Test 533 or the slump of the concrete as determined by ASTM Designation: C 143 is within the nominal values shown in the following table. When the penetration or slump of the concrete is found to exceed the nominal values listed, the mixture of subsequent batches shall be adjusted to reduce the penetration or slump to a value within the nominal range shown. Batches of concrete with a penetration or slump exceeding the maximum values listed shall not be used in the work. If Type F or Type G chemical admixtures are added to the mix, the penetration requirements shall not apply and the slump shall not exceed 9 inches after the chemical admixtures are added.

<table>
<thead>
<tr>
<th>Type of Work</th>
<th>Nominal Penetration (inches)</th>
<th>Slump (inches)</th>
<th>Maximum Penetration (inches)</th>
<th>Slump (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Pavement</td>
<td>0 - 1</td>
<td>—</td>
<td>1 1/2</td>
<td>—</td>
</tr>
<tr>
<td>Non-reinforced concrete facilities</td>
<td>0 - 1 1/2</td>
<td>—</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>Reinforced concrete structures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sections over 12 inches thick</td>
<td>0 - 1 1/2</td>
<td>—</td>
<td>2 1/2</td>
<td>—</td>
</tr>
<tr>
<td>Sections 12 inches thick or less</td>
<td>0 - 2</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Concrete placed under water</td>
<td>—</td>
<td>6 - 8</td>
<td>—</td>
<td>9</td>
</tr>
<tr>
<td>Cast-in-place concrete piles</td>
<td>2 1/2 - 3 1/2</td>
<td>5 - 7</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

• The amount of free water used in concrete shall not exceed 310 pounds per cubic yard, plus 20 pounds for each required 100 pounds of cementitious material in excess of 550 pounds.
per cubic yard.

• The term free water is defined as the total water in the mixture minus the water absorbed by the aggregates in reaching a saturated surface-dry condition.

• If there are adverse or difficult conditions that affect the placing of concrete, the above specified penetration and free water content limitations may be exceeded providing the Contractor is granted permission by the Engineer in writing to increase the cementitious material content per cubic yard of concrete. The increase in water and cementitious material shall be at a ratio not to exceed 30 pounds of water per added 100 pounds of cementitious material per cubic yard. Full compensation for additional cementitious material and water added under these conditions shall be considered as included in the contract price paid for the concrete work involved and no additional compensation will be allowed therefor.

• The equipment for supplying water to the mixer shall be constructed and arranged so that the amount of water added can be measured accurately. Any method of discharging water into the mixer for a batch shall be accurate within 1.5 percent of the quantity of water required to be added to the mix for any position of the mixer. Tanks used to measure water shall be designed so that water cannot enter while water is being discharged into the mixer and discharge into the mixer shall be made rapidly in one operation without dribbling. All equipment shall be arranged so as to permit checking the amount of water delivered by discharging into measured containers.

90-7 CURING CONCRETE

90-7.01 METHODS OF CURING

• Newly placed concrete shall be cured by the methods specified in this Section 90-7.01 and the technical specifications.

90-7.01A WATER METHOD

• The concrete shall be kept continuously wet by the application of water for a minimum curing period of 7 days after the concrete has been placed.

• Cotton mats, rugs, carpets, or earth or sand blankets may be used as a curing medium to retain the moisture during the curing period.

• If a curing medium consisting of cotton mats, rugs, carpets, polyethylene sheeting, polyethylene sheeting on burlap, or earth or sand blankets is to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing media.

• At the option of the Contractor, a curing medium consisting of white opaque polyethylene sheeting extruded onto burlap may be used to cure concrete structures. The polyethylene sheeting shall have a minimum thickness of 4-mil, and shall be extruded onto 10-ounce burlap.

• At the option of the Contractor, a curing medium consisting of polyethylene sheeting may be used to cure concrete columns. The polyethylene sheeting shall have a minimum
thickness of 10-mil achieved in a single layer of material.

- If the Contractor chooses to use polyethylene sheeting or polyethylene sheeting on burlap as a curing medium, these media and any joints therein shall be secured as necessary to provide moisture retention and shall be within 3 inches of the concrete at all points along the surface being cured. When these media are used, the temperature of the concrete shall be monitored during curing. If the temperature of the concrete cannot be maintained below 140°F, use of these curing media shall be disallowed.
- When concrete bridge decks and flat slabs are to be cured without the use of a curing medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified above, until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

**90-7.01B CURING COMPOUND METHOD**

- Surfaces of the concrete that are exposed to the air shall be sprayed uniformly with a curing compound.

- Curing compounds to be used shall be as follows:
  1. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B, except the resin type shall be poly-alpha-methylstyrene.
  2. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B.
  3. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class A.
  4. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class B.
  5. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class A.
  6. Nonpigmented curing compound with fugitive dye conforming to the requirements in ASTM Designation: C 309, Type 1-D, Class A.

- The infrared scan for the dried vehicle from curing compound (1) shall match the infrared scan on file at the Transportation Laboratory.
- The loss of water for each type of curing compound, when tested in conformance with the requirements in California Test 534, shall not be more than 0.28-pounds per square yard in 24 hours.
- The curing compound to be used will be specified elsewhere in these specifications or in the technical specifications.
- If the use of curing compound is required or permitted elsewhere in these specifications or in the technical specifications and no specific kind is specified, any of the curing compounds listed above may be used.
- Curing compound shall be applied at a nominal rate of one gallon per 150 square feet, unless otherwise specified.
• At any point, the application rate shall be within ±50 square feet per gallon of the nominal rate specified, and the average application rate shall be within ±25 square feet per gallon of the nominal rate specified when tested in conformance with the requirements in California Test 535. Runs, sags, thin areas, skips, or holidays in the applied curing compound shall be evidence that the application is not satisfactory.

• Curing compounds shall be applied using power operated spray equipment. The power operated spraying equipment shall be equipped with an operational pressure gage and a means of controlling the pressure. Hand spraying of small and irregular areas that are not reasonably accessible to mechanical spraying equipment, in the opinion of the Engineer, may be permitted.

• The curing compound shall be applied to the concrete following the surface finishing operation, immediately before the moisture sheen disappears from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any drying or cracking of the surface, application of water with an atomizing nozzle as specified in Section 90-7.01A, "Water Method," shall be started immediately and shall be continued until application of the compound is resumed or started; however, the compound shall not be applied over any resulting freestanding water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures and 72 hours in the case of pavement, the damaged portion shall be repaired immediately with additional compound.

• At the time of use, compounds containing pigments shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. A paddle shall be used to loosen all settled pigment from the bottom of the container, and a power driven agitator shall be used to disperse the pigment uniformly throughout the vehicle.

• Agitation shall not introduce air or other foreign substance into the curing compound.

• The manufacturer shall include in the curing compound the necessary additives for control of sagging, pigment settling, leveling, de-emulsification, or other requisite qualities of a satisfactory working material. Pigmented curing compounds shall be manufactured so that the pigment does not settle badly, does not cake or thicken in the container, and does not become granular or curdled. Settlement of pigment shall be a thoroughly wetted, soft, mushy mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sideways manual motion of the paddle across the bottom of the container, to form a smooth uniform product of the proper consistency.

• Curing compounds shall remain sprayable at temperatures above 40° F and shall not be diluted or altered after manufacture.

• The curing compound shall be packaged in clean 274-gallon totes, 55-gallon barrels or 5-gallon pails shall be supplied from a suitable storage tank located at the jobsite. The containers shall comply with "Title 49, Code of Federal Regulations, Hazardous Materials Regulations." The 274-gallon totes and the 55-gallon barrels shall have removable lids and airtight fasteners. The 5-gallon pails shall be round and have standard full open head and bail. Lids with bungholes will not be permitted. Settling or separation of solids in containers, except tanks, must be completely redispersed with low speed mixing prior to use, in conformance with these specifications and the manufacturer's recommendations. Mixing shall be accomplished either manually by use of a paddle or by use of a mixing blade driven by a drill motor, at low speed. Mixing blades shall be the type used for mixing paint. On-site storage tanks shall be kept
clean and free of contaminants. Each tank shall have a permanent system designed to completely redisperse settled material without introducing air or other foreign substances.

- Steel containers and lids shall be lined with a coating that will prevent destructive action by the compound or chemical agents in the air space above the compound. The coating shall not come off the container or lid as skins. Containers shall be filled in a manner that will prevent skinning. Plastic containers shall not react with the compound.
- Each container shall be labeled with the manufacturer's name, kind of curing compound, batch number, volume, date of manufacture, and volatile organic compound (VOC) content. The label shall also warn that the curing compound containing pigment shall be well stirred before use. Precautions concerning the handling and the application of curing compound shall be shown on the label of the curing compound containers in conformance with the Construction Safety Orders and General Industry Safety Orders of the State.
- Containers of curing compound shall be labeled to indicate that the contents fully comply with the rules and regulations concerning air pollution control in the State.
- When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.
- Curing compound will be sampled by the Engineer at the source of supply, at the job site, or at both locations.
- Curing compound shall be formulated so as to maintain the specified properties for a minimum of one year. The Engineer may require additional testing before use to determine compliance with these specifications if the compound has not been used within one year or whenever the Engineer has reason to believe the compound is no longer satisfactory.
- Tests will be conducted in conformance with the latest ASTM test methods and methods in use by the Transportation Laboratory.

**90-7.01C WATERPROOF MEMBRANE METHOD**

- The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the curing membrane, shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.
- Sheeting material for curing concrete shall conform to the requirements in AASHTO Designation: M 171 for white reflective materials.
- The sheeting material shall be fabricated into sheets of such width as to provide a complete cover for the entire concrete surface. Joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 0.33-foot.
- The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.
- Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.
- Sections of membrane that have lost their waterproof qualities or have been damaged to
such an extent as to render them unfit for curing the concrete shall not be used.

90-7.01D FORMS-IN-PLACE METHOD

- Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 20 inches in least dimension the forms shall remain in place for a minimum period of 5 days.
- Joints in the forms and the joints between the end of forms and concrete shall be kept moisture tight during the curing period. Cracks in the forms and cracks between the forms and the concrete shall be resealed by methods subject to the approval of the Engineer.

90-7.02 CURING PAVEMENT

- The entire exposed area of the pavement, including edges, shall be cured by the waterproof membrane method, or curing compound method using curing compound (1) or (2) as the Contractor may elect. Should the side forms be removed before the expiration of 72 hours following the start of curing, the exposed pavement edges shall also be cured. If the pavement is cured by means of the curing compound method, the sawcut and all portions of the curing compound that have been disturbed by sawing operations shall be restored by spraying with additional curing compound.
- Curing shall commence as soon as the finishing process provided in Section 40-1.10, "Final Finishing," has been completed. The method selected shall conform to the provisions in Section 90-7.01, "Methods of Curing."
- When the curing compound method is used, the compound shall be applied to the entire pavement surface by mechanical sprayers. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator that provides for continual agitation of the curing compound during the time of application. The spray shall be adequately protected against wind, and the nozzles shall be so oriented or moved mechanically transversely as to result in the minimum specified rate of coverage being applied uniformly on exposed faces. Hand spraying of small and irregular areas, and areas inaccessible to mechanical spraying equipment, in the opinion of the Engineer, will be permitted. When the ambient air temperature is above 60° F, the Contractor shall fog the surface of the concrete with a fine spray of water as specified in Section 90-7.01A, "Water Method." The surface of the pavement shall be kept moist between the hours of 10:00 a.m. and 4:30 p.m. on the day the concrete is placed. However, the fogging done after the curing compound has been applied shall not begin until the compound has set sufficiently to prevent displacement. Fogging shall be discontinued if ordered in writing by the Engineer.

90-7.03 CURING STRUCTURES

- Newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, in conformance with the provisions in Section 90-7.01, "Methods of Curing."
- The curing compound method using a pigmented curing compound may be used on
concrete surfaces of construction joints, surfaces that are to be buried underground, and surfaces where only ordinary surface finish is to be applied and on which a uniform color is not required and that will not be visible from a public travele way. If the Contractor elects to use the curing compound method on the bottom slab of box girder spans, the curing compound shall be curing compound (1).

- The top surface of highway bridge decks shall be cured by both the curing compound method and the water method. The curing compound shall be curing compound (1).
- Concrete surfaces of minor structures, as defined in Section 51-1.02, "Minor Structures," shall be cured by the water method, the forms-in-place method or the curing compound method.
- When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required. Application of water for this purpose will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

90-7.04 CURING PRECAST CONCRETE MEMBERS

- Precast concrete members shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing." Curing shall be provided for the minimum time specified for each method or until the concrete reaches its design strength, whichever is less. Steam curing may also be used for precast members and shall conform to the following provisions:

A. After placement of the concrete, members shall be held for a minimum 4-hour presteaming period. If the ambient air temperature is below 50° F, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 50° F and 90° F.

B. To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered as soon as possible after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.

C. Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner as to prevent the loss of steam and moisture.

D. Steam at the jets shall be at low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 40° F per hour. The curing temperature throughout the enclosure shall not exceed 150° F and shall be maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature is representative of the average temperature of the enclosure.

E. Temperature recording devices that will provide an accurate, continuous, permanent record of the curing temperature shall be provided. A minimum of one temperature
recording device per 200 feet of continuous bed length will be required for checking temperature.

F. Members in pretension beds shall be detensioned immediately after the termination of steam curing while the concrete and forms are still warm, or the temperature under the enclosure shall be maintained above 60° F until the stress is transferred to the concrete.

G. Curing of precast concrete will be considered completed after termination of the steam curing cycle.

90-7.07 CURING MISCELLANEOUS CONCRETE WORK

• Exposed surfaces of curbs shall be cured by pigmented curing compounds as specified in Section 90-7.01B, "Curing Compound Method."
• Concrete sidewalks, gutter depressions, island paving, curb ramps, driveways, and other miscellaneous concrete areas shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."
• Shotcrete shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."
• Mortar and grout shall be cured by keeping the surface damp for 3 days.
• After placing, the exposed surfaces of sign structure foundations, including pedestal portions, if constructed, shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

90-8 PROTECTING CONCRETE

90-8.01 GENERAL

• In addition to the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials," the Contractor shall protect concrete as provided in this Section 90-8. If required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.
• The Contractor shall protect concrete from damage from any cause, which shall include, but not be limited to: rain, heat, cold, wind, Contractor's actions, and actions of others.
• Concrete shall not be placed on frozen or ice-coated ground or subgrade nor on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints.
• Under rainy conditions, placing of concrete shall be stopped before the quantity of surface water is sufficient to dam age surface mortar or cause a flow or wash of the concrete surface, unless the Contractor provides adequate protection against damage.
• Concrete that has been frozen or damaged by other causes, as determined by the Engineer, shall be removed and replaced by the Contractor at the Contractor's expense.

90-8.02 PROTECTING CONCRETE STRUCTURES

• Structure concrete and shotcrete used as structure concrete shall be maintained at a temperature of not less than 45° F for 72 hours after placing and at not less than 40° F for an additional 4 days.
90-9 COMpressive Strength

90-9.01 GENERAL

• Concrete compressive strength requirements consist of a minimum strength that shall be attained before various loads or stresses are applied to the concrete and, for concrete designated by strength, a minimum strength at the age of 28 days or at the age otherwise allowed in Section 90-1.01, "Description." The various strengths required are specified in these specifications or the technical specifications or are shown on the plans.

• The compressive strength of concrete will be determined from test cylinders that have been fabricated from concrete sampled in conformance with the requirements of California Test 539. Test cylinders will be molded and initially field cured in conformance with California Test 540. Test cylinders will be cured and tested after receipt at the testing laboratory in conformance with the requirements of California Test 521. A strength test shall consist of the average strength of 2 cylinders fabricated from material taken from a single load of concrete, except that, if any cylinder should show evidence of improper sampling, molding, or testing, that cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinder.

• When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, test cylinders for other than steam cured concrete will be cured in conformance with Method 1 of California Test 540. The compressive strength of concrete determined for these purposes will be evaluated on the basis of individual tests.

• When concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete strength to be used as a basis for acceptance of other than steam cured concrete will be determined from cylinders cured in conformance with Method 1 of California Test 540. If the result of a single compressive strength test at the maximum age specified or allowed is below the specified strength but is 95 percent or more of the specified strength, the Contractor shall make corrective changes, subject to approval of the Engineer, in the mix proportions or in the concrete fabrication procedures, before placing additional concrete, and shall pay to the State $10 for each in-place cubic yard of concrete represented by the deficient test. If the result of a single compressive strength test at the maximum age specified or allowed is below 95 percent of the specified strength, but is 85 percent or more of the specified strength, the Contractor shall make the corrective changes specified above, and shall pay to the State $15 for each in-place cubic yard of concrete represented by the deficient test. In addition, such corrective changes shall be made when the compressive strength of concrete tested at 7 days indicates, in the judgment of the Engineer, that the concrete will not attain the required compressive strength at the maximum age specified or allowed. Concrete represented by a single test that indicates a compressive strength of less than 85 percent of the specified 28-day compressive strength will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials."

• If the test result indicates that the compressive strength at the maximum curing age specified or allowed is below the specified strength, but is 85 percent or more of the specified strength, payments to the State as required above shall be made, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength
of the concrete placed in the work meets or exceeds the specified 28-day compressive strength. If the test result indicates a compressive strength at the maximum curing age specified or allowed below 85 percent, the concrete represented by that test will be rejected, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength and quality of the concrete placed in the work are acceptable. If the evidence consists of tests made on cores taken from the work, the cores shall be obtained and tested in conformance with the requirements in ASTM Designation: C 42.

- No single compressive strength test shall represent more than 320 cubic yards.
- If a precast concrete member is steam cured, the compressive strength of the concrete will be determined from test cylinders that have been handled and stored in conformance with Method 3 of California Test 540. The compressive strength of steam cured concrete will be evaluated on the basis of individual tests representing specific portions of production. If the concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete shall be considered to be acceptable whenever its compressive strength reaches the specified 28-day compressive strength provided that strength is reached in not more than the maximum number of days specified or allowed after the member is cast.
- When concrete is specified by compressive strength, prequalification of materials, mix proportions, mixing equipment, and procedures proposed for use will be required prior to placement of the concrete. Prequalification shall be accomplished by the submission of acceptable certified test data or trial batch reports by the Contractor. Prequalification data shall be based on the use of materials, mix proportions, mixing equipment, procedures, and size of batch proposed for use in the work.
- Certified test data, in order to be acceptable, shall indicate that not less than 90 percent of at least 20 consecutive tests exceed the specified strength at the maximum number of cure days specified or allowed, and none of those tests are less than 95 percent of specified strength. Strength tests included in the data shall be the most recent tests made on concrete of the proposed mix design and all shall have been made within one year of the proposed use of the concrete.
- Trial batch test reports, in order to be acceptable, shall indicate that the average compressive strength of 5 consecutive concrete cylinders, taken from a single batch, at not more than 28 days (or the maximum age allowed) after molding shall be at least 580 pounds per square inch greater than the specified 28-day compressive strength, and no individual cylinder shall have a strength less than the specified strength at the maximum age specified or allowed. Data contained in the report shall be from trial batches that were produced within one year of the proposed use of specified strength concrete in the project. Whenever air-entrainment is required, the air content of trial batches shall be equal to or greater than the air content specified for the concrete without reduction due to tolerances.
- Tests shall be performed in conformance with either the appropriate California Test methods or the comparable ASTM test methods. Equipment employed in testing shall be in good condition and shall be properly calibrated. If the tests are performed during the life of the contract, the Engineer shall be notified sufficiently in advance of performing the tests in order to witness the test procedures.
The certified test data and trial batch test reports shall include the following information:

A. Date of mixing.
B. Mixing equipment and procedures used.
C. The size of batch in cubic yards and the weight, type, and source of all ingredients used.
D. Penetration or slump (if the concrete will be placed under water or placed in cast-in-place concrete piles) of the concrete.
E. The air content of the concrete if an air-entraining admixture is used.
F. The age at time of testing and strength of all concrete cylinders tested.

Certified test data and trial batch test reports shall be signed by an official of the firm that performed the tests.

When approved by the Engineer, concrete from trial batches may be used in the work at locations where concrete of a lower quality is required and the concrete will be paid for as the type or class of concrete required at that location.

After materials, mix proportions, mixing equipment, and procedures for concrete have been prequalified for use, additional prequalification by testing of trial batches will be required prior to making changes that, in the judgment of the Engineer, could result in a strength of concrete below that specified.

The Contractor's attention is directed to the time required to test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date so that the progress of the work is not delayed.

When precast concrete members are manufactured at the plant of an established manufacturer of precast concrete members, the mix proportions of the concrete shall be determined by the Contractor, and a trial batch and prequalification of the materials, mix proportions, mixing equipment, and procedures will not be required.

SECTION 91: PAINT

Issue Date: May 1, 2006

Section 91-3, "Paints for Timber," of the Standard Specifications is amended to read:

91-3 PAINTS FOR TIMBER

91-3.01 WOOD PRIMER, LATEX-BASE

Classification:

This specification covers a ready-mixed priming paint for use on unpainted wood or exterior woodwork. It shall conform with the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI) for exterior wood primers, and be listed on the Exterior Latex Wood Primer MPI List Number 6.
91-3.02 PAINT; LATEX-BASE FOR EXTERIOR WOOD, WHITE AND TINTS

Classification:

- This specification covers a ready-mixed paint for use on wood surfaces subject to outside exposures. This paint shall conform to the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI) for Paint, Latex, Exterior, and shall be listed on the following MPI Approved Products List:

  A. Exterior Latex, Flat MPI Gloss Level 1, MPI List Number 10.
  B. Exterior Latex, Semi-Gloss, MPI Gloss Level 5, MPI List Number 11.
  C. Exterior Latex, Gloss, MPI Gloss Level 6, MPI List Number 119.

- Unpainted wood shall first be primed with wood primer conforming to the provisions in Section 91-3.01, "Wood Primer, Latex-Base."

Section 91-4, "Miscellaneous Paints," of the Standard Specifications is amended to read:

91-4 MISCELLANEOUS PAINTS

91-4.01 THROUGH 91-4.04 (BLANK)

91-4.05 PAINT; ACRYLIC EMULSION, EXTERIOR WHITE AND LIGHT AND MEDIUM TINTS

Classification:

- This specification covers an acrylic emulsion paint designed for use on exterior masonry. This paint shall conform to the requirements in the Detailed Performance Standards of the Master Painters Institute (MPI) for Paint, Latex, Exterior, and shall be listed on the following MPI Approved Products Lists:

  A. Exterior Latex, Flat MPI Gloss Level 1, MPI List Number 10.
  B. Exterior Latex, Semi-Gloss, MPI Gloss Level 5, MPI List Number 11.
  C. Exterior Latex, Gloss, MPI Gloss Level 6, MPI List Number 119.

- This paint may be tinted by using "universal" or "all purpose" concentrates.

3.2 GENERAL

Engineering Fabric

Engineering fabrics shall conform to the provisions in Section 88, "Engineering Fabrics," of the Standard Specifications and these technical specifications.

Filter fabric for this project shall be ultraviolet (UV) ray protected.
Portland Cement Concrete

Portland cement concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these technical specifications.

The Department of Transportation maintains a list of sources of fine and coarse aggregate that have been approved for use with a reduced amount of supplementary cementitious material in the total amount of cementitious material to be used. A source of aggregate will be considered for addition to the approved list if the producer of the aggregate submits to the Engineer certified test results from a qualified testing laboratory that verify the aggregate complies with the requirements. Approval of aggregate will depend upon compliance with the specifications, based on the certified test results submitted, together with any replicate testing the Engineer may require.

Qualified testing laboratories shall conform to the following requirements:

1. Laboratories performing ASTM Designation: C 1293 shall participate in the Cement and Concrete Reference Laboratory (CCRL) Concrete Proficiency Sample Program and shall have received a score of 3 or better on each test of the previous 2 sets of concrete samples.
2. Laboratories performing ASTM Designation: C 1260 shall participate in the Cement and Concrete Reference Laboratory (CCRL) Pozzolan Proficiency Sample Program and shall have received a score of 3 or better on the shrinkage and soundness tests of the previous 2 sets of pozzolan samples.

Aggregates on the list shall conform to one of the following requirements:

1. When the aggregate is tested in conformance with the requirements in California Test 554 and ASTM Designation: C 1293, the average expansion at one year shall be less than or equal to 0.040 percent; or
2. When the aggregate is tested in conformance with the requirements in California Test 554 and ASTM Designation: C 1260, the average of the expansion at 16 days shall be less than or equal to 0.15 percent.

If the aggregates used in the concrete are on the Department of Transportation’s list, the minimum amount of supplementary cementitious material shall conform to the following:

1. If fly ash or natural pozzolan conforming to the provisions in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications is used, the minimum amount of supplementary cementitious material shall be 15 percent by weight of the total cementitious material; or
2. If silica fume conforming to the provisions in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications is used, the minimum amount of supplementary cementitious material shall be 7 percent by weight of the total cementitious material.
The limitation on tricalcium silicate (C₃S) content in Type II cement specified in Section 90-2.01A, "Cement," of the Standard Specifications shall not apply.

**Welding - General**

Flux cored welding electrodes conforming to the requirements of AWS A5.20 E6XT-4 or E7XT-4 shall not be used to perform welding for this project.

Wherever the abbreviation AWS is used, it shall be equivalent to the abbreviations ANSI/AWS or AASHTO/AWS.

Requirements of the AWS welding codes shall apply unless otherwise specified in the Standard Specifications, on the plans, or in these technical specifications. Wherever reference is made to the following AWS welding codes in the Standard Specifications, on the plans, or in these technical specifications, the year of adoption for these codes shall be as listed:

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<th>AWS Code</th>
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<tr>
<td>D1.1</td>
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<tr>
<td>D1.4</td>
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<tr>
<td>D1.5</td>
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</tr>
<tr>
<td>D1.6</td>
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</tr>
</tbody>
</table>

Section 6.1.1.1 of AWS D1.5 is replaced with the following:

Quality Control (QC) shall be the responsibility of the Contractor. As a minimum, the Contractor shall perform inspection and testing of each weld joint prior to welding, during welding, and after welding as specified in this section and as necessary to ensure that materials and workmanship conform to the requirements of the contract documents.

Unless otherwise specified, Sections 6.1.3 through 6.1.4.3 of AWS D1.1, Section 7.1.2 of AWS D1.4, and Sections 6.1.1.2 through 6.1.3.3 of AWS D1.5 are replaced with the following:

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all welding.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

The QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship, and shall be currently certified as an AWS Certified Welding Inspector (CWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors."

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The QC Inspector may be assisted by an Assistant QC Inspector provided that this individual is currently certified as an AWS Certified Associate Welding Inspector (CAWI) in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors." The Assistant QC Inspector may perform inspection under the direct supervision of the QC Inspector provided the assistant is always within visible and audible range of the QC Inspector. The QC Inspector shall be responsible for signing all reports and for determining if welded materials conform to workmanship and acceptance criteria. The ratio of QC Assistants to QC Inspectors shall not exceed 5 to 1.

When the term "Inspector" is used without further qualification, it shall refer to the QC Inspector.

When any work is welded in conformance with the provisions in Section 75, "Miscellaneous Metal," of the Standard Specifications, not including Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications, Section 6.1.4 of AWS D1.1 is replaced with the following:

The QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship and shall be currently certified as an AWS CWI in conformance with the requirements in AWS QC1, "Standard for AWS Certification of Welding Inspectors," or as a Welding Inspector Specialist (WIS) in conformance with the requirements in AWS B5.2, "Specification for the Qualification of Welding Inspector Specialists and Welding Inspector Assistants."

Section 6.14.6, "Personnel Qualification," of AWS D1.1, Section 7.8, "Personnel Qualification," of AWS D1.4, and Section 6.1.3.4, "Personnel Qualification," of AWS D1.5 are replaced with the following:

Personnel performing nondestructive testing (NDT) shall be qualified and certified in conformance with the requirements of the American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A and the Written Practice of the NDT firm. The Written Practice of the NDT firm shall meet or exceed the guidelines of the ASNT Recommended Practice No. SNT-TC-1A. Individuals who perform NDT, review the results, and prepare the written reports shall be either:

A. Certified NDT Level II technicians, or;
B. Level III technicians who hold a current ASNT Level III certificate in that discipline and are authorized and certified to perform the work of Level II technicians.

Section 6.5.4 of AWS D1.5 is replaced with the following:

The QC Inspector shall inspect and approve each joint preparation, assembly practice, welding technique, joint fit-up, and the performance of each welder, welding operator, and tack welder to
make certain that the applicable requirements of this code and the approved Welding Procedure Specification (WPS) are met. The QC Inspector shall examine the work to make certain that it meets the requirements of Sections 3 and 6.26. The size and contour of all welds shall be measured using suitable gages. Visual inspection for cracks in welds and base metal, and for other discontinuities shall be aided by strong light, magnifiers, or such other devices as may be helpful. Acceptance criteria different from those specified in this code may be used when approved by the Engineer.

Section 6.6.5, "Nonspecified NDT Other than Visual," of AWS D1.1, Section 7.6.5 of AWS D1.4 and Section 6.6.5 of AWS D1.5 shall not apply.

For any welding, the Engineer may direct the Contractor to perform NDT that is in addition to the visual inspection or NDT specified in the AWS or other specified welding codes, in the Standard Specifications, or in these technical specifications. Except as provided for in these technical specifications, additional NDT required by the Engineer, and associated repair work, will be paid for as extra work as provided in Section 4-1.03D, "Extra Work," of the Standard Specifications. Prior to release of welded material by the Engineer, if testing by NDT methods other than those originally specified discloses an attempt to defraud or reveals a gross nonconformance, all costs associated with the repair of the deficient area, including NDT of the weld and of the repair, and any delays caused by the repair, shall be at the Contractor’s expense. A gross nonconformance is defined as the sum of planar type rejectable indications in more than 20 percent of the tested length.

When less than 100 percent of NDT is specified for any weld, it is expected that the entire length of weld meet the specified acceptance-rejection criteria. Should any welding deficiencies be discovered by additional NDT directed or performed by the Engineer that utilizes the same NDT method as that originally specified, all costs associated with the repair of the deficient area, including NDT of the weld and of the weld repair, and any delays caused by the repair, shall be at the Contractor's expense.

Repair work to correct welding deficiencies discovered by visual inspection directed or performed by the Engineer, and any associated delays or expenses caused to the Contractor by performing these repairs, shall be at the Contractor’s expense.

The Engineer shall have the authority to verify the qualifications or certifications of any welder, QC Inspector, or NDT personnel to specified levels by retests or other means approved by the Engineer.

Inspection and approval of all joint preparations, assembly practices, joint fit-ups, welding techniques, and the performance of each welder, welding operator, and tack welder shall be documented by the QC Inspector on a daily basis for each day welding is performed. For each inspection, including fit-up, Welding Procedure Specification (WPS) verification, and final weld inspection, the QC Inspector shall confirm and document compliance with the requirements of
the AWS or other specified code criteria and the requirements of these technical specifications on all welded joints before welding, during welding, and after the completion of each weld.

In addition to the requirements specified in the applicable code, the period of effectiveness for a welder's or welding operator's qualification shall be a maximum of 3 years for the same weld process, welding position, and weld type. If welding will be performed without gas shielding, then qualification shall also be without gas shielding. Excluding welding of fracture critical members, a valid qualification at the beginning of work on a contract will be acceptable for the entire period of the contract, as long as the welder's or welding operator's work remains satisfactory.

In addition to the requirements of AWS D1.1, welding procedures qualification for work welded in conformance with that code shall conform to the following requirements:

A. The travel speed, amperage, and voltage values that are used for tests conducted per AWS D1.1, Section 4.1.1, shall be consistent for each pass in a weld joint and shall in no case vary by more than ±10 percent for travel speed, ±10 percent for amperage, and ±7 percent for voltage as measured from a predetermined target value or average within each weld pass. The travel speed shall in no case vary by more than ±15 percent when using submerged arc welding.

B. When a nonstandard weld joint is to be made using a combination of WPSs, a single test may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 4.5.

In addition to the requirements of AWS D1.5, Section 5.12 or 5.13, welding procedures qualification for work welded in conformance with that code shall conform to the following requirements:

A. Unless considered prequalified, fillet welds shall be qualified in each position. The fillet weld soundness test shall be conducted using the essential variables of the WPS as established by the Procedure Qualification Record (PQR).

B. For qualification of joints that do not conform to Figures 2.4 and 2.5 of AWS D1.5, a minimum of two WPS qualification tests are required. The tests shall be conducted using both Figure 5.1 and Figure 5.3. The test conforming to Figure 5.1 shall be conducted in conformance with AWS D1.5, Section 5.12 or 5.13. The test conforming to Figure 5.3 shall be conducted using the welding electrical parameters that were established for the test conducted conforming to Figure 5.1. The ranges of welding electrical parameters established during welding per Figure 5.1 in conformance with AWS D1.5, Section 5.12, shall be further restricted according to the limits in Table 5.3 during welding per Figure 5.3.

C. Multiple zones within a weld joint may be qualified. The travel speed, amperage, and voltage values that are used for tests conducted per AWS D1.5 Section 5.13 shall be
consistent for each pass in a weld joint, and shall in no case vary by more than ±10 percent for travel speed, ±10 percent for amperage, and ±7 percent for voltage as measured from a predetermined target value or average within each weld pass or zone. The travel speed shall in no case vary by more than ±15 percent when using submerged arc welding.

D. For a WPS qualified in conformance with AWS D1.5 Section 5.13, the values to be used for calculating ranges for current and voltage shall be based on the average of all weld passes made in the test. Heat input shall be calculated using the average of current and voltage of all weld passes made in the test for a WPS qualified in conformance with Section 5.12 or 5.13.

E. Macroetch tests are required for WPS qualification tests, and acceptance shall be per AWS D1.5 Section 5.19.3.

F. When a nonstandard weld joint is to be made using a combination of WPSs, a test conforming to Figure 5.3 may be conducted combining the WPSs to be used in production, provided the essential variables, including weld bead placement, of each process are limited to those established in Table 5.3.

G. Prior to preparing mechanical test specimens, the PQR welds shall be inspected by visual and radiographic tests. Backing bar shall be 3 inches in width and shall remain in place during NDT testing. Results of the visual and radiographic tests shall comply with AWS D1.5 Section 6.26.2, excluding Section 6.26.2.2. Test plates that do not comply with both tests shall not be used.

### Welding - Quality Control

Welding quality control shall conform to the requirements in the AWS or other specified welding codes, the Standard Specifications, and these technical specifications.

Unless otherwise specified, welding quality control shall apply when any work is welded in conformance with the provisions in Section 49, "Piling," Section 52, "Reinforcement," Section 55, "Steel Structures," or Section 75-1.035, "Bridge Joint Restrainer Units," of the Standard Specifications.

All welding will require inspection by the Engineer. The Contractor shall request inspection at least 3 working days prior to the beginning of welding.

Continuous inspection shall be provided when any welding is being performed. Continuous inspection, as a minimum, shall include having a QC Inspector within such close proximity of all welders or welding operators so that inspections by the QC Inspector of each welding operation at each welding location does not lapse for a period exceeding 30 minutes.

The Contractor shall designate in writing a welding Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of welding, including materials and workmanship, performed by the Contractor and subcontractors.
The QCM shall be the sole individual responsible to the Contractor for submitting, receiving, reviewing, and approving all correspondence, required submittals, and reports to and from the Engineer. The QCM shall be a registered professional engineer or shall be currently certified as a CWI.

Unless the QCM is hired by a subcontractor providing only QC services, the QCM shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project. The QCM may be an employee of the Contractor.

Welding inspection personnel or NDT firms to be used in the work shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project, except for the following conditions:

A. The work is welded in conformance with AWS D1.5 and is performed at a permanent fabrication or manufacturing facility that is certified under the AISC Quality Certification Program, Category Cbr, Major Steel Bridges and Fracture Critical endorsement F, when applicable.

B. The welding is performed on pipe pile material at a permanent pipe manufacturing facility authorized to apply the American Petroleum Institute (API) monogram for API 5L pipe.

For welding performed at such facilities, the inspection personnel or NDT firms may be employed or compensated by the facility performing the welding provided the facility maintains a QC program that is independent from production.

In addition to the requirements in AWS D1.1 and AWS D1.5, second-time excavations of welds or base metal to repair unacceptable discontinuities, regardless of NDT method, and all repairs of cracks require prior approval of the Engineer.

Order of Work

Order of work shall conform to the provisions in Section 5-1.05, "Order of Work," of the Standard Specifications and these technical specifications.

Steel Soldier Piles

Attention is directed to the sections “Steel Soldier Piles” of these technical specifications. The first order of work shall be ordering steel soldier piles.

Welding
Attention is directed to the section “Welding” and “Welding Quality Control” of these technical specifications. Prior to performing welding work, a prewelding meeting between the Engineer, the Contractor's QCM, and a representative from each entity performing welding or inspection for this project, shall be held to discuss the requirements for the WQCP. The Contractor shall then submit to the Engineer, for review and approval, a separate WQCP for each subcontractor or supplier for each item of work for which welding is to be performed.

Tieback Anchors

Attention is directed to the section “Tieback Anchors” of these technical specifications. Prior to performing tieback anchor installation, the Contractor shall submit a complete working drawing submittal for tieback anchor assemblies to the Engineer, for review.

Progress Schedules

Progress schedules are required for this project and shall conform to the provisions in Section 8-1.04, "Progress Schedule,” of the Standard Specifications.

A minimum of 48 hours notice shall be given to the Engineer by the Contractor prior to any work requiring inspection. Failure to provide at least 48 hours notice may result in the Engineer rejecting the work. Said notice shall include the date and time of the scheduled work.

Obstructions

Attention is directed to Section 8-1.10, "Utility and Non-Highway Facilities," and Section 15, "Existing Highway Facilities," of the Standard Specifications and these technical specifications.

The Contractor shall notify the Engineer and the appropriate regional notification center for operators of subsurface installations at least 2 working days, but not more than 14 calendar days, prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire or other structure. Regional notification centers include, but are not limited to, the following:

<table>
<thead>
<tr>
<th>Notification Center</th>
<th>Telephone Number</th>
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<tbody>
<tr>
<td>Underground Service Alert-Northern California (USA)</td>
<td>(800) 642-2444</td>
</tr>
<tr>
<td></td>
<td>(800) 227-2600</td>
</tr>
<tr>
<td>Underground Service Alert-Southern California (USA)</td>
<td>(800) 422-4133</td>
</tr>
<tr>
<td></td>
<td>(800) 227-2600</td>
</tr>
</tbody>
</table>

Mobilization

Earthwork

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications, the Soils Reports by Miller Pacific Engineering Group noted in Section 1.2, “Reference Standards and Quality Assurance”, and these technical specifications.

Drilling, sampling and soil testing was performed by Miller Pacific Engineering Group. The Engineer assumes no responsibility for the accuracy of sufficiency of this data, nor is there any guarantee, either expressed or implied, that unforeseen conditions may not be encountered in the work.

Copies of the Soils Report are available for review at the office of the Soils Engineer.

In case of conflict between the Soils Report and the Standard Specifications and/or these Technical specifications, the Soils Report shall take precedence over and be used in lieu of such conflicting provisions.

Full compensation for conforming to all of the earthwork requirements in the Soils Report, the project plans and these technical specifications shall be considered as included in the contract prices for the items involved and no additional compensation will be allowed therefor.

Surplus excavated material shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Reinforcement or metal attached to reinforced concrete rubble placed in embankments shall not protrude above the grading plane. Prior to placement within 2 feet below the grading plane of embankments, reinforcement or metal shall be trimmed to no greater than 3/4 inch from the face of reinforced concrete rubble. Full compensation for trimming reinforcement or metal shall be considered as included in the contract prices paid per cubic yard for the types of excavation shown in the Engineer's estimate, or the contract prices paid for furnishing and placing imported borrow or embankment material, as the case may be, and no additional compensation will be allowed therefor.

Imported borrow shall be mineral material including rock, sand, gravel, or earth. The Contractor shall not use man-made refuse in imported borrow including:

A. Portland cement concrete.
B. Asphalt concrete.
C. Material planed from roadway surfaces.
D. Residue from grooving or grinding operations.
E. Metal.
F. Rubber.

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G. Mixed debris.
H. Rubble.

Geocomposite Drains

Geocomposite drains shall conform to the details shown on the plans and the following:

A. Attention is directed to "Engineering Fabrics" under "Materials" of these technical specifications.
B. Geocomposite drain shall consist of a manufactured core not less than 0.25 inch thick nor more than 2 inches thick with one or both sides covered with a layer of filter fabric that will provide a drainage void. The drain shall produce a flow rate, through the drainage void, of at least 2.0 gallons per minute per foot of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 5,000 psf.
C. A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for the geocomposite drain certifying that the drain produces the required flow rate and complies with these technical specifications. The Certificate of Compliance shall be accompanied by a flow capability graph for the geocomposite drain showing flow rates for externally applied pressures and hydraulic gradients. The flow capability graph shall be stamped with the verification of an independent testing laboratory.
E. The manufactured core shall be either a preformed grid of embossed plastic, a mat of random shapes of plastic fibers, a drainage net consisting of a uniform pattern of polymeric strands forming 2 sets of continuous flow channels, or a system of plastic pillars and interconnections forming a semirigid mat.
F. The core material and filter fabric shall be capable of maintaining the drainage void for the entire height of geocomposite drain. Filter fabric shall be integrally bonded to the side of the core material with the drainage void. Core material manufactured from impermeable plastic sheeting having nonconnecting corrugations shall be placed with the corrugations approximately perpendicular to the drainage collection system.
G. The geocomposite drain shall be installed with the drainage void and the filter fabric facing the embankment. The fabric facing the embankment side shall overlap a minimum of 3 inches at all joints and wrap around the exterior edges a minimum of 3 inches beyond the exterior edge. If additional fabric is needed to provide overlap at joints and wrap-around at edges, the added fabric shall overlap the fabric on the geocomposite drain at least 6 inches and be attached thereto.
H. Should the fabric on the geocomposite drain be torn or punctured, the damaged section shall be replaced completely or repaired by placing a piece of fabric that is large enough to cover the damaged area and provide a minimum 6-inch overlap.
I. Plastic pipe shall conform to the provisions for edge drain pipe and edge drain outlets in Section 68-3, "Edge Drains," of the Standard Specifications.
J. Treated permeable base to be placed around the slotted plastic pipe at the bottom of the geocomposite drain shall be cement treated permeable base conforming to the provisions for cement treated permeable base in Section 29, "Treated Permeable Bases," of the Standard Specifications and these technical specifications.

K. The treated permeable base shall be enclosed with a high density polyethylene sheet or PVC geomembrane, not less than 10 mils thick, which is bonded with a suitable adhesive to the concrete and geocomposite drain. Surfaces to receive the polyethylene sheet shall be cleaned before applying the adhesive. The treated permeable base shall be compacted with a vibrating shoe type compactor.

Structure Backfill (Soldier Pile Wall)

Material for structure backfill behind lagging shall conform to the “Earthwork” section of these technical specifications. Structure backfill directly behind lagging shall be compacted by hand tamping, mechanical compaction, or other means approved by the Engineer.

Structure backfill in fill areas behind the lagging shall be keyed into the existing back slope.

Backfill behind the lagging shall be in place and compacted to 1.5 ft above the level of the tiebacks prior to drilling for the tiebacks. The remainder of the backfill behind the lagging shall be placed and compacted after tiebacks are drilled, stressed, and grouted.

Concrete Backfill

Concrete backfill of the type encasing the steel soldier piles below the lagging shall be Class 2 concrete conforming to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these technical specifications.

Construction Equipment Loads

Any construction vehicle or equipment, other than standard grading and compaction equipment, proposed to be driven or operated behind the retaining wall shall not weigh more than an HS20-44 design vehicle. Any proposed construction vehicle or equipment, other than standard grading and compaction equipment, that weighs more than the HS20-44 design vehicle shall be submitted to the Engineer for review prior to use.

Piling

General

Section 49, "Piling," of the Standard Specifications, and these technical specifications.

Unless otherwise specified, welding of any work performed in conformance with the provisions
in Section 49, "Piling," of the Standard Specifications, shall be in conformance with the requirements in AWS D1.1.

Attention is directed to “Steel Soldier Piling” and "Welding" of these technical specifications.

Difficult pile installation is anticipated due to the presence of fractured sandstone and greenstone materials, intermittent ground water and underground utilities.

Steel Soldier Piling

This work shall consist of furnishing and installing steel piling; securing the piling prior to and during concrete encasement; and shaping the tops of the piles; in accordance with the details shown on the plans, and these technical specifications.

Materials

Steel soldier piles shall be structural shapes ASTM A992, Fy=50,000 psi and plates shall be ASTM A572, Fy = 50,000 psi. Steel soldier piles shall be unused and in good condition, and shall conform to the provisions in Section 55, “Steel Structures” of the Standard Specifications, and these technical specifications.

Cleaning and painting of steel soldier piles shall conform to the provisions in the section “Clean and Paint Steel Soldier Piling” of these technical specifications.

Construction

Steel soldier piles shall be placed in a drilled hole and shall be battered and aligned before placing concrete backfill and embankment backfill. Alignment shall be maintained while placing backfill material in the drilled holes.

Drilled Holes

Holes for steel soldier piles shall be drilled into natural foundation materials at the location shown on the plans and shall conform to Section 49, "Piling," of the Standard Specifications and these technical specifications.

Drilled holes shall be accurately located and shall be battered as indicated on the plans. When the piles are battered and aligned, the steel piles shall be at least three inches clear of the sides of the hole for the full length of the hole to be filled with concrete backfill. Holes that do not provide the clearance around steel piles shall be reamed or enlarged at the Contractor's expense.

Construction Tolerances: The CIDH pile shall be drilled and the steel soldier pile placed in the CIDH pile to satisfy the following tolerances:
1. The horizontal alignment of the front face of the steel soldier pile shall be within 0.10-feet of the Retaining Wall Layout Line (RWLOL). The steel pile shall be at least 3 inches clear of the sides of the drilled hole, as noted above.

2. The soldier pile shall not be out of the required batter alignment perpendicular to the Retaining Wall Layout Line (RWLOL), nor the vertical plumbness parallel to the Retaining Wall Layout Line (RWLOL), more than the lesser of the following: 0.7 percent over the wall design height, nor 0.10-feet.

Steel soldier pile horizontal alignment, batter alignment (perpendicular to the RWLOL) and plumbness (parallel to the RWLOL) tolerances shall be measured and recorded by the inspector after the CIDH pile concrete has set up and prior to beginning of the wall backfilling operation. Piles that do not meet the tolerances outlined above will be rejected.

Temporary casings or tremie seals shall be furnished and placed where necessary to control water or to prevent caving of the hole.

Difficult drilling is anticipated due to the presence of fractured sandstone and greenstone materials, intermittent ground water and underground utilities.

Loose materials existing at the bottom of the hole after drilling operations have been completed shall be removed before placing the pile.

Materials resulting from drilling holes shall be disposed of in conformance with the provisions in Section 19-2.06, "Surplus Material," of the Standard Specifications.

Drilling mud or chemical stabilizers shall not be used. Surface water shall not be permitted to enter the hole and all water in the hole shall be removed before placing concrete therein.

Casing, if used in drilling operations, shall be removed from the hole as concrete is placed therein. The bottom of the casing shall be maintained not more than 5 feet nor less than one foot below the top of the concrete during casing withdrawal and concrete placing operations. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing. The methods used to withdraw temporary casings shall preclude contamination of the concrete and commingling of the soil and concrete or of any ground water and concrete.

If piles with larger diagonal dimensions are substituted for the piles shown on the plans, the Contractor shall, at the Contractor's expense, ream or enlarge the drilled hole to provide a hole diameter at least 6 inches larger than the diagonal dimension of the pile.

**Tieback Anchors**
Anchors at the soldier pile retaining walls, consisting of holes drilled in foundation material, grouted steel bars or strands, and anchorage assemblies, and testing of installed anchors shall conform to the details shown on the plans, the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications, and these technical specifications. Whenever “member” is referred to in Section 50, “Prestressing Concrete,” of the Standard Specifications, it shall be considered to mean tieback anchor.

Difficult tieback installation is anticipated due to the presence of fractured sandstone and greenstone materials, intermittent ground water, and underground utilities.

Intermittent ground water is likely to be encountered during construction of tieback anchors. The geotechnical engineer will provide recommendations for appropriate measures to capture water and alleviate hydrostatic pressure. The installation of Caltrans standard vertical drains (hydro-augers) may be required at some locations.

The Contractor shall determine the bond length necessary to meet acceptance criteria specified herein.

In fabricating, handling, shipping, and placing tieback anchors, adequate care shall be taken to avoid damage to the sheathing. Damage to the sheathing caused by handling and fabrication prior to tieback anchor installation shall be repaired or replaced as determined by the Engineer. Repair procedure for the sheathing shall be included in the working drawings.

**Materials**

Whenever "member" is referred to in Section 50, "Prestressing Concrete," of the Standard Specifications, it shall be considered to mean tieback anchor.

Structural steel for the tieback components shall conform to the provisions in Section 55, "Steel Structures," of the Standard Specifications and these technical specifications. Structural steel shall consist of the anchorage assembly and the anchorage enclosure. The anchorage assembly and the anchorage enclosure shall be galvanized. The provisions of "Welding Quality Control" of these technical specifications shall not apply to the anchorage enclosure or to the weld between the steel tube and the bearing plate of the anchorage assembly for tiebacks. Those provisions shall apply to all other welds of structural steel for tieback retaining walls.

Cleaning and painting structural steel for tieback retaining walls shall conform to the provisions in "Clean and Paint Steel Soldier Piling" of these technical specifications.

Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. Fine aggregate may be added to the grout mixture of cement and water used outside of the grouted sheathing in drilled holes which are 8 inches or greater in diameter, but only to the extent that the cement content of the grout is not less than 845 pounds per cubic

The plastic sheathing for tieback anchors shall conform to one of the following: polyvinyl chloride (PVC) sheathing, high density polyethylene (HDPE) sheathing, or polypropylene sheathing.

Corrugated plastic sheathing shall be PVC or HDPE. The width of corrugations, the distance between corrugations, and the height of corrugations of corrugated plastic sheathing shall be approximately the same.

PVC sheathing may be used for smooth sheathing for bar tendons, and may be used for corrugated sheathing for either strand or bar tendons. PVC sheathing shall conform to ASTM Designation: D 1784, Class 13464-B. Corrugated PVC sheathing shall have a nominal wall thickness of 40 mils. HDPE sheathing may be used for smooth sheathing for bar tendons, and may be used for corrugated sheathing for either strand or bar tendons. HDPE sheathing shall have a density between 940 kg/m$^3$ and 960 kg/m$^3$ as measured in accordance with ASTM Designation: D 792, A-2. Corrugated HDPE sheathing shall have a nominal wall thickness of 60 mils for sheathing with an outside diameter of 3 inches or greater, and a nominal thickness of 40 mils for sheathing with an outside diameter less than 3 inches, with a tolerance of minus 10 mils.

HDPE sheathing may be used for the smooth sheathing encapsulating individual strands of strand type tendons. Smooth HDPE sheathing for encapsulating strands shall have a minimum wall thickness of 40 mils. Polypropylene sheathing may be used for the smooth plastic sheathing encapsulating individual strands of strand type tendons. Polypropylene sheathing shall have a density between 900 kg/m$^3$ and 910 kg/m$^3$. Smooth polypropylene sheathing shall have a minimum wall thickness of 40 mils.

The smooth sheathing for the unbonded length of the individual strands, including joints, shall have sufficient strength to prevent damage during construction operations and shall be watertight, chemically stable without embrittlement or softening, and nonreactive with concrete, steel, or corrosion inhibiting grease.

The corrugated sheathing, including joints, shall have sufficient strength to prevent damage during construction operations and shall be grout-tight and watertight, chemically stable without embrittlement or softening, and nonreactive with concrete, steel, or corrosion inhibiting grease.

The transition between the corrugated plastic sheathing and the anchorage assembly shall be an approved detail that allows stressing to the design force without evidence of distress in the corrugated plastic sheathing.

Additional requirements for tiebacks with strand type tendons are as follows:
A. The individual strands of a tendon, except for the bonded length, shall be fully coated with corrosion inhibiting grease and then encapsulated by a smooth HDPE or polypropylene sheath. The corrosion inhibiting grease shall fill all space between strand wires and shall encapsulate the strand giving an encasement diameter at least 5 mils greater than the diameter of the bare strand. The sheath shall be hot melt extruded onto the strand or shall be shop applied by an approved method that assures that all spaces between the sheath and the strand and between the strand wires are filled with corrosion inhibiting grease.

B. The corrosion inhibiting grease shall provide a continuous nonbrittle film of corrosion protection to the prestressing steel and lubrication between the strand and the sheathing, shall resist flow from the sheathing, shall be chemically stable and nonreactive with the prestressing steel, sheathing material, and concrete, and shall be organic with appropriate polar, moisture displacing, and corrosion inhibiting additives.

C. The corrosion inhibiting grease shall have the physical properties listed in Table 3.2.1 of the Post Tensioning Manual, Fifth Edition, by the Post Tensioning Institute with the following revisions:
   1. Test 5., Corrosion Test. The environment shall always be considered as corrosive for the purposes of determining the proper test criterion.
   3. Test 8.a., Compatibility with Sheathing, Hardness and volume change of polymer exposure to grease, 40 days @ 150°F. The test method shall be ASTM D 4289, except that ASTM D 792 shall be used to determine density.

D. At least 40 days before use, a sample from the lot to be used and test results shall be provided for the corrosion inhibiting grease.

Construction

Tieback anchors shall be installed in accordance with the manufacturer’s recommendations. In case of a conflict between the manufacturer’s recommendations and these technical specifications, these technical specifications shall prevail.

Water and grout from tieback anchor construction operations shall not fall on public traffic, flow across shoulders or lanes occupied by public traffic, or flow into landscaping, gutters, or other drainage facilities. Excessive amounts of water shall not be used in any of the drilling and the tieback anchor installation procedures.

Tieback anchor steel shall be protected prior to completion of all grouting against rust, corrosion, and physical damage in conformance with the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications. In addition, there shall be no evidence of distress in the plastic sheathing or crushing of the grout within the pregrounded sheathing.

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The tieback anchorage assembly shall be protected against rust, corrosion, and physical damage prior to completion of all grouting of enclosure or encasement in concrete.

The tieback anchor installation method selected by the Contractor shall be sufficient to achieve the loadings specified herein. Holes for tieback anchors shall be drilled in the foundation to a depth sufficient to provide the necessary bond length beyond the minimum unbonded length shown on the plans.

Tieback anchorage holes shall be drilled by either the rotary or rotary percussion drilling method.

The diameter of the drilled hole shall be large enough to provide a minimum of one inch grout cover within the bonded length of the tendon. Centralizers shall be used within the bonded length of the tendon.

Pregrouting shall occur at least 48 hours before placing the tendon in the drilled hole.

Prior to installing each anchor assembly into the drilled hole, the anchor assembly shall be clean and free of oil, grease, or other extraneous substances, and any damage to the sheathing shall be repaired or replaced.

Grout for all stages of tieback construction shall be injected at the low end of the void being filled and shall be expelled at the high end until there is no evidence of entrapped air, water, or diluted grout. The grout shall be placed using grout tubes, unless another method is approved by the Engineer. The quantity of the grout and the grout pressures shall be recorded.

After placing initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

Additional requirements for tiebacks with bar type tendons are as follows:

A. The bar tendons in the unbonded area shall be sheathed with smooth sheathing that extends into the steel tube of the permanent tieback anchorage assembly, as shown on the plans. For this portion of smooth sheathing there is no minimum wall thickness and the sheathing shall be either PVC or HDPE.

B. In addition, bar tendons shall be sheathed full-length with corrugated sheathing. The annular space between the bar and the corrugated sheathing shall be pregrouted prior to placing the tendons in the drilled hole. The bar shall be centered in the sheathing.

C. There shall be a seal between the smooth sheathing and the corrugated sheathing at the top and bottom of the length of smooth sheathing.

D. For bar tendons, the initial grout in the drilled hole may be placed before or after insertion of the bar tendon.
E. For drilled holes 6 inches in diameter or less, the initial grout outside of the corrugated sheathing shall extend to within 6 inches of the end of the steel tube of the anchorage assembly. Grout in the unbonded length shall not be placed under pressure. For drilled holes greater than 6 inches in diameter, the initial grout outside of the corrugated sheathing shall be within the limits of the bonded length. After placing the initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

Additional requirements for tiebacks with strand type tendons are as follows:

A. The Contractor shall have the option of using Alternative A or Alternative B as shown on the plans for tieback tendons.

B. For Alternative A and Alternative B, strand tendons shall be sheathed with corrugated sheathing. The individual strands within the bonded length shall be separated by spaces so that the entire surface of each strand is bonded in the grout. The maximum spacing of strand spacers shall be 5 feet. The strand spacers shall be plastic and of a construction and strength that will provide support for the individual strands during construction operations.

C. For Alternative A, the bonded length of the tendon shall be sheathed with corrugated sheathing and pregrouted full length of the corrugated sheathing before placing the tendon in the hole. The corrugated sheathing shall lap the smooth sheathing on the strands 2 feet. For this alternative, the initial grout in the drilled hole may be placed before or after insertion of the strand tendon.

D. For Alternative B, the tendon shall be sheathed full length with corrugated sheathing and pregrouted a minimum length of 2 feet before placing the tendon in the hole. After placing the tendon into the drilled hole and before placing initial grout in the drilled hole, the grout shall be injected at the low end of the corrugated sheathing and the grout shall be expelled at the high end until there is no evidence of entrapped air, water, or diluted grout.

E. For Alternative A and Alternative B, anchors in holes of 6 inches in diameter and smaller shall be initially grouted to within 6 inches of the end of the steel tube. Grout in the unbonded length shall not be placed under pressure. After placing the initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

F. For Alternative A and Alternative B, anchors in holes of greater than 6 inches in diameter shall be initially grouted within the bond length. After placing the initial grout, the anchor shall remain undisturbed until the grout has reached a strength sufficient to provide anchorage during testing operations.

Testing

All tiebacks shall be load tested by either a performance test or a proof test. Temporary yokes shall remain the property of the Contractor. The magnitude of applied test loads shall be
determined with a calibrated pressure gauge or a load cell.

The Contractor shall furnish to the Engineer for approval, documentation and calibration results indicating the date and results of the Caltrans Transportation Laboratory Calibration for the jack and pressure gages to be used for stressing. The Contractor shall furnish to the Engineer the certified calibration results a minimum of 5 working days prior to stressing.

Movements of the end of the tieback, relative to an independent fixed reference point, shall be measured and recorded to the nearest 0.001-inch at each load increment during the load tests. The Contractor shall perform the measuring and recording and shall furnish the Engineer copies of the recorded movements.

A minimum of 3 tiebacks, but not less than 10% of tiebacks shall be performance tested per wall. The Engineer shall determine the location of the tiebacks to be performance tested.

The performance test or proof test shall be conducted by measuring the test load applied to the tieback and the tieback end movement during incremental loading and unloading of the anchor in accordance with the loading schedule. The test load shall be held constant for 10 minutes. During the test load hold, the movement of the end of the tendon shall be measured at 1, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between one minute and 10 minutes exceeds 0.04-inch, the test load shall be held for an additional 50 minutes. Total movement shall be measured at 15, 20, 25, 30, 45, and 60 minutes. If the test load is held for 60 minutes, a creep curve showing the creep movement between one minute and 60 minutes shall be plotted as a function of the logarithm of time.

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T = Design force for the anchor shown on the plans
AL = Alignment load

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For performance and proof tests, each increment of load shall be applied in less than one minute and held for at least one minute but not more than 2 minutes or as specified above. The observation period for the load hold shall start when the pump begins to apply the last increment of load.

The jacking equipment, including the tendon movement measuring system, shall be stable during all phases of the tieback loading operations.

All tiebacks not performance tested shall be proof tested. If 1.5 times the design force cannot be obtained, the tieback shall be redesigned and replaced. Tieback anchors shall not be retested, unless the tieback bond length is post-grouted after the unacceptable test.

A performance tested tieback is acceptable if:

A. The measured elastic movement exceeds 0.80 of the theoretical elongation of the unbonded length plus the jacking length at the maximum test load; and
B. The creep movement between one and 10 minutes is less than 0.04-inch.

A proof tested tieback is acceptable if:

A. The pattern of movements is similar to that of adjacent performance tested tiebacks; and
B. The creep movement between one and 10 minutes is less than 0.04-inch.

Performance tested or proof tested tiebacks which fail to meet acceptance criterion B will be acceptable if the maximum load is held for 60 minutes and the creep curve plotted from the movement data indicates a creep rate of less than 0.08-inch for the last log cycle of time.

**Lock-off**

After successful testing of the tiebacks, the tiebacks shall be tensioned against the structure and locked off at the lock-off load shown on the plans. The lock-off force is the load on the jacks that is maintained while the anchor head or anchor nuts on the tieback are permanently set. Immediately after lock-off, a lift-off test shall be performed to demonstrate that the specified lock-off force was obtained. Adjustments in the shim thickness shall be made if required to maintain the specified lock-off force.

For strand tendons, the permanent wedges shall be fully set in the anchor head while the tendon is stressed to the test load of 1.50 T, and then locked off at the lock-off force by removal of the shims or other appropriate means.

Grouting to the level of Stage 2 grouting as shown on the plans shall be completed only after successful testing and lock-off has been completed. At least 24 hours after the secondary grout
has set, the remaining void in the steel tube and bearing plate shall be filled with grout. Grout shall be injected at the low end and expelled at the high end until there is no evidence of entrapped air or water. A minimum grout head of 2 feet shall be maintained until the grout has set.

The tieback anchor head or anchor nuts shall be enclosed with a grouted anchorage enclosure device. After grouting the steel tube, the bearing plate surface shall be cleaned, sealant placed, and the anchorage enclosure bolted in place. After bolting the anchorage enclosure in place the void in the anchorage enclosure shall be filled with grout by injecting grout at the low end of the void and venting at the high end. Any holes in the top of the anchorage enclosure used for grout placement shall be cleaned and sealed with sealant. Sealant shall be a non-sag polysulfide or polyurethane sealing compound conforming requirements in ASTM Designation: C 920.

**Timber Lagging**

Timber lagging shall conform to the details shown on the plans and the provisions in Sections 57, "Timber Structures," and 58, "Preservative Treatment of Lumber, Timber and Piling," of the Standard Specifications and these technical specifications.

All timber members shall be preservative treated Douglas fir of the grades shown on the plans. Timber members shall be rough sawn to the dimensions shown on the plans.

Preservative treatment shall conform to AWPA Use Category System: UC4B, Commodity Specification A, except that chromated copper arsenate shall not be used.

**Clean and Paint Steel Soldier Piling**

Steel piling surfaces shall be cleaned and painted in conformance with the provisions in Sections 59-2, "Painting Structural Steel," and 91, "Paint," of the Standard Specifications and these technical specifications. Limits of the steel soldier pile length to be dry blast cleaned and shop primed with the inorganic zinc coating shall be as shown on the plans.

Clean and paint steel soldier piling shall consist of dry blast cleaning and painting steel soldier piles with an inorganic zinc undercoat prior to pile installation.

The Contractor shall provide enclosures to permit cleaning and painting during inclement weather. Provisions shall be made to control atmospheric conditions inside the enclosures within suitable limits during cleaning and painting operations, drying to solvent insolubility, and throughout the curing period in accordance with the manufacturer's recommendations and these technical specifications. Full compensation for providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work requiring paint and no additional compensation will be allowed therefor.
Fresh, potable water with a maximum chloride content of 75 ppm and a maximum sulfate content of 200 ppm shall be used for water rinsing or pressure washing operations. No continuous recycling of rinse water will be permitted. If rinse water is collected into a tank and subsequent testing determines the collected water conforms to the specified requirements, reuse may be permitted by the Engineer if no collected water is added to the tank after sample collection for determination of conformance to specified requirements.

Open joints between concrete and painted or galvanized metal surfaces shall be caulked with non-silicone type sealing compound conforming to the requirements in Federal Specification TT-S-230, Type II, or other approved material. The sealing compound shall be applied no sooner than 24 hours after the high pressure cleaning has been applied. The sealing compound shall be allowed to cure as recommended by the manufacturer prior to the water rinsing and application of the first finish coat. When no finish coats are applied, the sealing compound shall be gray in color.

Cleaning

All designated piling surfaces to be blast cleaned shall be dry blast cleaned in conformance with the requirements of SSPC-SP 10, "Near White Blast Cleaning," of the "SSPC: The Society for Protective Coatings." Blast cleaning shall leave all surfaces with a dense, uniform, angular, anchor pattern of not less than 1.6 mils nor more than 3.5 mils as measured in conformance with the requirements in ASTM Designation: D 4417.

Mineral and slag abrasives used for blast cleaning steel surfaces shall conform to the requirements for Class A, Grade 2 to 3 abrasives contained in SSPC-AB 1, "Mineral and Slag Abrasives," of the "SSPC: The Society for Protective Coatings," and shall not contain hazardous material.

Steel abrasives used for blast cleaning steel surfaces shall comply with the requirements in SSPC-AB 3, "Ferrous Metallic Abrasive," of the "SSPC: The Society for Protective Coatings." If steel abrasive is recycled through shop or field abrasive blast cleaning units, the recycled abrasive shall conform to the requirements of SSPC-AB 2, "Specification for Cleanliness of Recycled Ferrous Metallic Abrasive," of the "SSPC: The Society for Protective Coatings."

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications and a Material Safety Data Sheet shall be furnished prior to use for each shipment of blast cleaning material to be used on steel.

Abrasive blast cleaned surfaces shall be tested by the Contractor for soluble salts using a Class A or B retrieval method as described in Technology Guide 15, "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates," of the "SSPC: The Society for Protective Coatings," and cleaned so the maximum level of soluble salts does not exceed the lesser of the coating manufacturer's written recommendations or 10 micrograms per square foot.
Areas of abrasive blast cleaned steel shall be tested at the rate of 3 tests for the first 1000 square feet prepared per day, and one test for each additional 1000 square feet or portion thereof, at locations selected by the Engineer. When less than 1000 square feet of surface area is prepared in a shift, at least 2 tests shall be performed. If levels of soluble salts exceed the maximum allowed by these technical specifications, the entire area represented by the testing will be rejected. The Contractor shall perform additional cleaning and testing of rejected areas until soluble salt levels conform to these requirements.

**Painting**

Blast cleaned surfaces shall receive a single undercoat where specified or shown on the plans, consisting of an inorganic zinc coating conforming to the requirements in AASHTO Designation: M 300, Type I or Type II, except that: 1) the first 3 sentences of Section 4.7, "Primer Field Performance Requirements," shall not apply for Type II coatings, and 2) the entire Section 4.7.1 shall not apply for either type of inorganic zinc coating.

If the Contractor proposes to use a Type I coating, the Contractor shall furnish to the Engineer for review documentation as required in Section 5.6 of AASHTO Designation: M 300.

If the Contractor proposes to use a Type II coating, the coating shall be selected from the qualified products list, which may be obtained from the Caltrans Transportation Laboratory. See the qualified products list:

http://www.dot.ca.gov/hq/esc/approved_products_list/

The color of the inorganic zinc coating shall match Federal Standard 595B No. 36373.

Inorganic zinc coating shall be used within 12 hours of initial mixing.


The single undercoat of inorganic zinc coating shall be applied to the required dry film thickness in 2 or more applications within 8 hours of the start of blast cleaning. Abrasive blast cleaned steel shall not be exposed to relative humidity exceeding 85 percent prior to application of the inorganic zinc coating.

The total dry film thickness of all applications of the single undercoat of inorganic zinc coating shall be not less than 4 mils nor more than 8 mils.

Areas where mudcracking occurs in the inorganic zinc coating shall be blast cleaned and repainted with inorganic zinc coating to the specified thickness.

Steel surfaces coated with Type II inorganic zinc coating shall be protected from conditions that
may cause the coating film to dissolve. The Contractor, at the Contractor's expense, shall repair areas where the coating has dissolved by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

Dry spray, or overspray, as defined in the Steel Structures Painting Manual, Volume 1, "Good Painting Practice," of the "SSPC: The Society for Protective Coatings," shall be removed prior to application of subsequent coats or final acceptance. Removal of dry spray shall be by screening or other methods that minimize polishing of the inorganic zinc surface. The dry film thickness of the coating after removal of dry spray shall be in conformance with the provisions for applying the single undercoat, as specified herein.

The Contractor shall test the inorganic zinc coating. The locations of the tests will be determined by the Engineer. The sequence of the testing operations shall be determined by the Contractor. The testing for adhesion and hardness will be performed no sooner than 72 hours after application of the single undercoat of inorganic zinc coating. At the Contractor's expense, satisfactory access shall be provided to allow the Engineer to determine the location of the tests.

The inorganic zinc coating shall pass the following tests:

A. The inorganic zinc coating shall have a minimum adhesion to steel of 600 psi when measured at no more than 3 locations on each pile using a self-aligning adhesion tester in conformance with the requirements in ASTM Designation: D 4541. If 2 or more of the locations tested fail to meet adhesion requirements, the entire area represented by the tests will be rejected. If one of the locations tested fails to meet adhesion requirements, an additional 3 locations shall be tested. Should any of the additional locations fail to meet adhesion requirements, the entire area represented by the tests will be rejected. The Contractor, at the Contractor's expense, shall repair the rejected area by blast cleaning and repainting with inorganic zinc to the specified thickness. Test locations for areas of inorganic zinc meeting adhesion testing requirements shall be repaired by application of organic zinc primer as specified in Section 91-1.04, "Materials," of the Standard Specifications to the specified minimum dry film thickness.

B. Areas of inorganic zinc coating where finish coats are to be applied shall be tested by the Contractor for soluble salts using a Class A or B retrieval method as described in Technology Guide 15, "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates," of the "SSPC: The Society for Protective Coatings," and cleaned so the maximum level of soluble salts does not exceed the lesser of the manufacturer's written recommendations or 10 micrograms per square centimeter. Areas of inorganic zinc coating shall be tested at the rate of 3 tests for the first 1000 square feet to be painted per day and one test for each additional 1000 square feet or portion thereof at locations selected by the Engineer. When less than 1000 square feet of surface area is painted in a shift, at least 2 tests shall be performed. If levels of soluble salts exceed the maximum allowed by these technical specifications, the entire area represented by the testing will be rejected. The Contractor shall perform additional
cleaning and testing of rejected areas until soluble salt levels conform to these requirements.

C. The inorganic zinc coating shall exhibit a solid, hard, and polished metal surface when firmly scraped with the knurled edge of a quarter. Inorganic zinc coating that is powdery, soft, or does not exhibit a polished metal surface, as determined by the Engineer, shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

Additional Requirements for Water Borne Inorganic Zinc Primers

A. The surface pH of the inorganic zinc primer shall be tested by wetting the surface with deionized water for a minimum of 15 minutes but no longer than 30 minutes and applying pH paper with a capability of measuring in increments of 0.5 pH units. At least 2 surface pH readings shall be taken for every 500 square feet or portion thereof. If less than 500 square feet of steel is coated in a single shift or day, at least 2 surface pH readings shall be taken for primer applied during that period. Application of finish coats will not be permitted until the surface pH is less than or equal to 7.

B. Dry to solvent insolubility for water borne inorganic zinc primers shall be determined in conformance with the requirements in ASTM Designation: D 4752, except that water shall be the solvent. The resistance rating shall be not less than 4. Areas of inorganic zinc coating shall be tested for solvent insolubility at the rate of one test per 500 square feet or portion thereof. Inorganic zinc coating represented by the tested area that does not meet the solvent insolubility requirements will be rejected. The Contractor, at the Contractor's expense, shall repair rejected areas by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

Additional Requirements for Solvent Borne Inorganic Zinc Primers

A. Dry to solvent insolubility for solvent borne inorganic zinc primers shall be determined in conformance with the requirements in ASTM Designation: D 4752. The resistance rating shall be not less than 4. Areas of inorganic zinc coating shall be tested for solvent insolubility at the rate of one test per 500 square feet or portion thereof. Inorganic zinc coating represented by the tested area that does not meet the solvent insolubility requirements will be rejected. The Contractor, at the Contractor's expense, shall repair rejected areas by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

B. Surface hardness of solvent borne inorganic zinc shall be a minimum 2H when measured in conformance with the requirements in ASTM Designation: D 3363. Areas of inorganic zinc coating shall be tested at the rate of one test per 500 square feet or portion thereof. Inorganic zinc coating that fails to meet the surface hardness requirements shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.
The Contractor, at the Contractor's expense, shall retest all rejected areas of inorganic zinc coating after repairs have been completed.

Finish coats will not be required.

**Repair**

Shop waterborne inorganic zinc coated surfaces of piling that are abraded or damaged at any time after the application of the shop coat shall be repaired prior to installation. If the repair area exceeds one percent of the total coated surface as determined by the Engineer, the Contractor shall repair the surface by blast cleaning and painting the surface with inorganic zinc coating as previously specified. If the repair area is less than one percent of the total coated surface, the Contractor will be permitted to repair the area by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 applications of unthinned zinc-rich primer (organic vehicle type) conforming to the provisions in Section 91, "Paint," of the Standard Specifications. Repair of abraded or damaged surfaces shall be at the Contractor's expense. Aerosol cans shall not be used.

The Contractor shall take precautions in order to protect the inorganic zinc coating on the soldier piles from damage during both pile installation and retaining wall construction.

After pile installation and before the backfilling operation begins, areas where the inorganic zinc coating has been damaged or has deteriorated shall be thoroughly cleaned, foreign substances shall be removed, and surfaces shall be spot painted with the same inorganic zinc coating to the specified thickness. After retaining wall construction is completed, areas where the inorganic zinc coating has been damaged on the front (exposed) face of the piles shall be cleaned and painted as described above. Damaged areas of inorganic zinc coating shall be blast cleaned and painted as specified in these technical specifications.

The contract lump sum price paid for clean and paint steel soldier piling shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in cleaning and painting piling, complete in place, including water rinsing, testing of inorganic zinc coating, and the protecting, cleaning and repair of surfaces prior to and after pile installation, as shown on the plans, as specified in the Standard Specifications and these technical specifications, and as directed by the Engineer.
PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The work included in this section consists of furnishing all material, supplies, equipment, tools, transportation and facilities, and performing all labor and services necessary for, and required in connection with, soil nail wall construction as described in the Caltrans Standard Specifications, and this section of the technical specifications and the accompanying drawings, or reasonably implied therefrom, except as hereinafter specifically excluded.

1.2 REFERENCE STANDARDS AND QUALITY ASSURANCE

A. The work embraced herein shall conform to the provisions in the Standard Specifications dated May 2006, and the Standard Plans dated May 2006, of the State of California, Department of Transportation insofar as the same may apply, and these technical specifications. In case of conflict between the Standard Specifications and these technical specifications, the technical specifications shall take precedence over and shall be used in lieu of the conflicting portions.

B. Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications, the applicable soils report(s) by Miller Pacific Engineering Group and these technical specifications.

C. See Section 3.0, “EXECUTION” of this special provision for quality assurance requirements. A minimum of 48 hours notice shall be given to the Engineer by the Contractor prior to any work requiring inspection. Failure to provide at least 48 hours notice may result in the Engineer rejecting the work. Said notice shall include the date and time of the scheduled work.

1.3 SUBMITTALS

A. Certificates of compliance submittals shall conform to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.
B. Working drawings submittals shall conform to the provisions in Section 5-1.02, “Plans and Working Drawings” of the Standard Specifications. Shop drawings shall be submitted sufficiently in advance of the start of the affected work to allow time for review by the Engineer and correction by the Contractor of the drawings without delaying the work.

C. Concrete Mix Designs, including mix design proportions, aggregate gradings, and certificates of compliance for aggregates, cement, water and mineral and chemical admixtures.

D. Soil Nail Wall Earthwork:

1. The Contractor shall submit a complete working drawing submittal for earthwork for each soil nail wall to the Engineer.

2. Working drawings for wall earthwork shall show the full name of the structure, as shown on the contract plans, on each drawing and calculation sheet. The Contractor's name, address, and telephone and fax numbers shall be shown on the working drawings. Each sheet shall be numbered in the lower right hand corner.

3. The working drawings for soil nail wall earthwork shall contain all information required for the construction and quality control of the earthwork, including the following:
   a. A proposed schedule and detailed construction sequence. The construction sequence shall include measures to ensure wall and slope stability during all stages of wall construction, including provisions for discontinuous rows of soil nails.
   b. Methods of excavation to the staged lifts indicated and types of excavation equipment.
   c. Temporary shoring plans.
   d. Drilling methods and equipment.
   e. Information on space requirements for installation equipment.
   f. A detailed construction dewatering plan addressing all elements necessary to divert, control, and dispose of surface water and ground water.
4. A supplement to the working drawings shall include the following:
   
a. At the Contractor's option, the Contractor may conduct additional geotechnical investigation, and perform independent slope stability calculations for all stages of construction, for the purpose of developing soil nail wall earthwork working drawings.
   
b. Information on provisions for working in the proximity of underground and overhead facilities.

5. The working drawings and supplement shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California.

E. Soil Nail Assembly:

1. The Contractor shall submit a complete working drawing submittal for soil nail assemblies to the Engineer.

2. Working drawing submittals for soil nail assemblies shall show the full name of the structure, as shown on the contract plans, on each drawing and calculation sheet. The Contractor's name, address, and telephone and fax numbers shall also be shown on the working drawings. Each working drawing sheet shall be numbered in the lower right hand corner of the sheet.

3. The working drawing submittal for soil nail assemblies shall contain all information required for the construction and quality control of the soil nail wall, including the following:
   
a. The proposed schedule and detailed construction sequence of the installation and grouting of soil nails, application of shotcrete, and construction of cast-in-place reinforced concrete.
   
b. Complete details, specifications and certificates of compliance for all the soil nail and test soil nail components, including the nail rebar, encapsulation materials and method of grouting the encapsulation, anchorage system and anchor plate, and type of packers or other appropriate devices to be used to ensure partial length grouting of test soil nails.
   
c. Grout mix designs and procedures involved in testing grout.
   
d. Grout placement procedures and equipment including minimum required cure time.
   
e. Details of the equipment proposed for testing soil nails, including jacking frame and appurtenant bracing, and the method and equipment for determining any displacement of the test soil nail relative to the grout during application of test loads.
   
f. Information on space requirements for installation equipment.
g. Drilling methods and equipment.
h. Wall plans and elevations indicating nail layout, length and spacing for the full length of each wall, including details for nail layout and spacing at layer transitions, wall angle points and corners, tiered walls, and tapered ends of walls.

4. The working drawing submittal shall be stamped and signed by an engineer who is registered as a Civil Engineer in the State of California.

5. No soil nails shall be fabricated or installed until the Engineer has approved, in writing, the working drawing submittal for soil nail assemblies.

6. The Contractor shall furnish to the Engineer for approval, documentation and calibration results indicating the date and results of the Caltrans Transportation Laboratory Calibration for the jack and pressure gages or load cells to be used for soil nail assembly testing. The Contractor shall furnish to the Engineer the certified calibration results a minimum of 5 working days prior to soil nail assembly testing.

7. The Contractor shall furnish to the Engineer complete test results for each soil nail assembly tested. Data for each test shall list key personnel, test loading equipment, test soil nail location, hole diameter and depth, bond length, type of soil, method of drilling, and amount of ground water encountered within the bond length. Test data shall also include the dates and times of drilling, test soil nail installation, grouting, and testing. The test load and amount of displacement shall be included in the test data when any displacement of the test soil nail relative to the grout occurs during application of the test load.

F. Shotcrete

1. Concrete mix designs, as noted above.

2. At least 4 weeks prior to constructing any shotcrete test panels, the Contractor shall submit a Quality Control Plan (QCP) for the proposed method of shotcrete placement. The plan shall include the following:

   a. The number and qualifications of nozzlepersons available to place shotcrete, the number of nozzlepersons on-site at any time during the shotcrete placement, description of their work schedule, and the procedures for avoiding fatigue of any nozzleperson.
   b. The proposed method of placing shotcrete, including, but not limited to, application rates, details of any proposed construction joints and their
locations, and methods for achieving the required thickness and surface finish.

c. The procedure for curing shotcrete surfaces.

d. The description of a debris containment system, to be used during the cleaning of bar reinforcing steel and concrete and placing of shotcrete, as required to provide for public safety.

e. No construction of shotcrete test panels shall be performed until the QCP is approved by the Engineer.

3. A copy of the test results from preconstruction test panel cores and production test cores shall be furnished to the Engineer within 5 days following completion of testing.

G. Reinforcing Shop Drawings: The Contractor shall submit to the Engineer for review, bar reinforcing steel shop drawings. Working drawings shall be submitted sufficiently in advance of the start of the affected work to allow time for review by the Engineer and correction by the Contractor of the drawings without delaying the work.

H. Progress Schedule, including schedule updates produced as the work progresses.

PART 2 PRODUCTS

A. See Section 1.2, “REFERENCE STANDARDS AND QUALITY ASSURANCE” and Section 3.0, “EXECUTION” of this special provision for product compliance requirements.

PART 3 EXECUTION

3.1 AMENDMENTS TO CALTRANS STANDARD SPECIFICATIONS

Amendments to the Standard Specifications set forth in these technical specifications shall be considered as part of the Standard Specifications for the purposes set forth in Section 5-1.04, "Coordination and Interpretation of Plans, Standard Specifications and Technical specifications," of the Standard Specifications. Whenever either the term "Standard Specifications is amended" or the term "Standard Specifications are amended" is used in the technical specifications, the text or table following the term shall be considered an amendment to the Standard Specifications. In case of conflict between such amendments and the Standard Specifications, the amendments shall take precedence over and be used in lieu of the conflicting portions.

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The first sentence of the eleventh paragraph of Section 51-1.05, "Forms," of the Standard Specifications is amended to read:

- Form panels for exposed surfaces shall be furnished and placed in uniform widths of not less than 3 feet and in uniform lengths of not less than 6 feet, except at the end of continuously formed surfaces where the final panel length required is less than 6 feet.

The first sentence of the eleventh paragraph of Section 51-1.06C, "Removing Falsework," of the Standard Specifications is amended to read:

- Falsework for box culverts and other structures with decks lower than the roadway pavement and with span lengths of 14 feet or less shall not be released until the last placed concrete has attained a compressive strength of 1,600 psi, provided that curing of the concrete is not interrupted.

The fourth paragraph in Section 51-1.12D, "Sheet Packing, Preformed Pads, and Board Fillers," of the Standard Specifications is amended to read:

- Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a minimum flexural strength of 35 psi determined in conformance with the requirements in ASTM Designation: C 203 and a compressive yield strength of between 16 and 40 psi at 5 percent compression. Surfaces of expanded polystyrene against which concrete is placed shall be faced with hardboard. Hardboard shall be 1/8 inch minimum thickness, conforming to ANSI A135.4, any class. Other facing materials may be used provided they furnish equivalent protection. Boards shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

The table in the sixth paragraph of Section 51-1.12F, "Sealed Joints," of the Standard Specifications is amended to read:

<table>
<thead>
<tr>
<th>Movement Rating (MR)</th>
<th>Seal Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR ≤ 5/8 inch</td>
<td>Type A or Type B</td>
</tr>
<tr>
<td>5/8 inch &lt; MR ≤ 1-1/4 inches</td>
<td>Type A (silicone only) or Type B</td>
</tr>
<tr>
<td>1-1/4 inches &lt; MR ≤ 2 inches</td>
<td>Type B</td>
</tr>
<tr>
<td>2 inches &lt; MR ≤ 4 inches</td>
<td>Joint Seal Assembly (Strip Seal)</td>
</tr>
<tr>
<td>MR &gt; 4 inches</td>
<td>Joint Seal Assembly (Modular Unit) or Seismic Joint</td>
</tr>
</tbody>
</table>

The first sentence of the eleventh paragraph of Section 51-1.12F(3)(b), "Type B Seal," of the Standard Specifications is amended to read:

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• Samples of the prefabricated joint seals, not less than 3 feet in length, will be taken by the Engineer from each lot of material.

The fourth and fifth sentences of the sixth paragraph of Section 51-1.12H(1), "Plain and Fabric Reinforced Elastomeric Bearing Pads," of the Standard Specifications are amended to read:

• Each ply of fabric shall have a breaking strength of not less than 800 pounds per inch of width in each thread direction when 3” x 36” samples are tested on split drum grips. The bond between double plies shall have a minimum peel strength of 20 pounds per inch.

The hardness (Type A) requirement in the table in the eighth paragraph of Section 51-1.12H(1), "Plain and Fabric Reinforced Elastomeric Bearing Pads," of the Standard Specifications is amended to read:

| Hardness (Type A) | D 2240 with 2kg mass. | 55 ±5 |

The first sentence of subparagraph A of the first paragraph of Section 51-1.12H(2), "Steel Reinforced Elastomeric Bearings," of the Standard Specifications is amended to read:

• The bearings shall consist of alternating steel laminates and internal elastomer laminates with top and bottom elastomer covers. Steel laminates shall have a nominal thickness of 0.075 inch (14 gage).

The first paragraph in Section 51-1.135, "Mortar," of the Standard Specifications is amended to read:

• Mortar shall be composed of cementitious material, sand, and water proportioned and mixed as specified in this Section 51-1.135.

The third paragraph in Section 51-1.135, "Mortar," of the Standard Specifications is amended to read:

• The proportion of cementitious material to sand, measured by volume, shall be one to 2 unless otherwise specified.

The third sentence of the fourth paragraph of Section 51-1.17, "Finishing Bridge Decks," of the Standard Specifications is amended to read:

• The surfaces shall have a profile trace showing no high points in excess of 0.25 inch, and the portions of the surfaces within the traveled way shall have a profile count of 5 or less in any 100-foot section.

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SECTION 52: REINFORCEMENT

Issue Date: May 30, 2006

The table in the eleventh paragraph of Section 52-1.07, "Placing," of the Standard Specifications is amended to read:

<table>
<thead>
<tr>
<th>Height Zone (H) (Feet above ground)</th>
<th>Wind Pressure Value (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H ≤ 30</td>
<td>20</td>
</tr>
<tr>
<td>30 &lt; H ≤ 50</td>
<td>25</td>
</tr>
<tr>
<td>50 &lt; H ≤ 100</td>
<td>30</td>
</tr>
<tr>
<td>H &gt; 100</td>
<td>35</td>
</tr>
</tbody>
</table>

The table in the second paragraph of Section 52-1.08B(1), "Mechanical Splices," of the Standard Specifications is amended to read:

<table>
<thead>
<tr>
<th>Reinforcing Bar Number</th>
<th>Total Slip</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.010-inch</td>
</tr>
<tr>
<td>5</td>
<td>0.010-inch</td>
</tr>
<tr>
<td>6</td>
<td>0.010-inch</td>
</tr>
<tr>
<td>7</td>
<td>0.014-inch</td>
</tr>
<tr>
<td>8</td>
<td>0.014-inch</td>
</tr>
<tr>
<td>9</td>
<td>0.014-inch</td>
</tr>
<tr>
<td>10</td>
<td>0.018-inch</td>
</tr>
<tr>
<td>11</td>
<td>0.018-inch</td>
</tr>
<tr>
<td>14</td>
<td>0.024-inch</td>
</tr>
<tr>
<td>18</td>
<td>0.030-inch</td>
</tr>
</tbody>
</table>

The subparagraph under the sixth paragraph of Section 52-1.08B(2), "Butt Welded Splices," of the Standard Specifications is amended to read:

- The minimum preheat and interpass temperatures shall be 400º F for Grade 40 bars and 600º F for Grade 60 bars. Immediately after completing the welding, at least 6 inches of the bar on each side of the splice shall be covered by an insulated wrapping to control the rate of cooling. The insulated wrapping shall remain in place until the bar has cooled below 200º F.

The first sentence of the fifth paragraph of Section 52-1.08C, "Service Splice and Ultimate Butt Splice Testing Requirements," of the Standard Specifications is amended to read:

- Prequalification and production sample splices shall be 1) a minimum length of 5 feet for reinforcing bars No. 9 and smaller, and 6.5 feet for reinforcing bars No. 10 and larger, with the splice located at mid-point; and 2) suitably identified before shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals.
The second sentence of the second paragraph of Section 52-1.08C(3), "Ultimate Butt Splice Test Criteria," of the Standard Specifications is amended to read:

- Control bars shall be 1) a minimum length of 5 feet for reinforcing bars No. 9 and smaller, and 6.5 feet for reinforcing bars No. 10 and larger, and 2) suitably identified before shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals.

**SECTION 53: SHOTCRETE**

Issue Date: January 5, 2007

The third paragraph in Section 53-1.01, "Description," of the Standard Specifications is amended to read:

- The dry-mix process shall consist of delivering dry mixed aggregate and cementitious material pneumatically or mechanically to the nozzle body and adding water and mixing the materials in the nozzle body. The wet-mix process shall consist of delivering mixed aggregate, cement, and water pneumatically to the nozzle and adding any admixture at the nozzle.

The first through fourth paragraphs in Section 53-1.02, "Materials," of the Standard Specifications is amended to read:

- Cementitious material, fine aggregate, and mixing water shall conform to the provisions in Section 90, "Portland Cement Concrete."
- Shotcrete to be mixed and applied by the dry-mix process shall consist of one part cementitious material to not more than 4.5 parts fine aggregate, thoroughly mixed in a dry state before being charged into the machine. Measurement may be either by volume or by weight. The fine aggregate shall contain not more than 6 percent moisture by weight.
- Shotcrete to be mixed and applied by the wet-mix process shall consist of cementitious material, fine aggregate, and water and shall contain not less than 632 pounds of cementitious material per cubic yard. A maximum of 30 percent pea gravel may be substituted for fine aggregate. The maximum size of pea gravel shall be such that 100 percent passes the 1/2 inch screen and at least 90 percent passes the 3/8 inch screen.
- Admixtures may be added to shotcrete and shall conform to the provisions in Section 90-4, "Admixtures."

Item C of the third paragraph in Section 53-1.04, "Placing Shotcrete," of the Standard Specifications is amended to read:

C. Aggregate and cementitious material that have been mixed for more than 45 minutes shall not be used unless otherwise permitted by the Engineer.
SECTION 83: RAILINGS AND BARRIERS

Issue Date: January 5, 2007

The seventh paragraph in Section 83-1.02, "Materials and Construction," of the Standard Specifications is amended to read:

• Mortar shall conform to the provisions in Section 51-1.135, "Mortar," and shall consist of one part by volume of cementitious material and 3 parts of clean sand.

Item b of the first paragraph in Section 83-2.02D(2), "Materials," of the Standard Specifications is amended to read:

b. If the 3/8-inch maximum size aggregate grading is used to construct extruded or slip-formed concrete barriers, the cementitious material content of the minor concrete shall be not less than 675 pounds per cubic yard.

The third paragraph in Section 83-2.02D(2), "Materials," of the Standard Specifications is amended to read:

• The concrete paving between the tops of the 2 walls of concrete barrier (Types 50E, 60E, 60GE, and 60SE) and the optional concrete slab at the base between the 2 walls of concrete barrier (Types 50E, 60E, 60GE, and 60SE) shall be constructed of minor concrete conforming to the provisions of Section 90-10, "Minor Concrete," except that the minor concrete shall contain not less than 505 pounds of cementitious material per cubic yard.

SECTION 90: PORTLAND CEMENT CONCRETE

Issue Date: January 5, 2007

Section 90, "Portland Cement Concrete," of the Standard Specifications is amended to read:

SECTION 90: PORTLAND CEMENT CONCRETE

90-1 GENERAL

90-1.01 DESCRIPTION

• Portland cement concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in these specifications.
• The Contractor shall determine the mix proportions for concrete in conformance with these specifications.
• Class 1 concrete shall contain not less than 675 pounds of cementitious material per cubic yard.
• Class 2 concrete shall contain not less than 590 pounds of cementitious material per cubic yard.
• Class 3 concrete shall contain not less than 505 pounds of cementitious material per cubic yard.
• Class 4 concrete shall contain not less than 420 pounds of cementitious material per cubic yard.
• Minor concrete shall contain not less than 550 pounds of cementitious material per cubic yard unless otherwise specified in these specifications or the technical specifications.
• Unless otherwise designated on the plans or specified in these specifications or the technical specifications, the amount of cementitious material used per cubic yard of concrete in structures or portions of structures shall conform to the following:

<table>
<thead>
<tr>
<th>Use</th>
<th>Cementitious Material Content (Pounds/CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete designated by compressive strength:</td>
<td></td>
</tr>
<tr>
<td>Deck slabs and slab spans of bridges</td>
<td>675 min., 800 max.</td>
</tr>
<tr>
<td>Roof sections of exposed top box culverts</td>
<td>675 min., 800 max.</td>
</tr>
<tr>
<td>Other portions of structures</td>
<td>590 min., 800 max.</td>
</tr>
<tr>
<td>Concrete not designated by compressive strength:</td>
<td></td>
</tr>
<tr>
<td>Deck slabs and slab spans of bridges</td>
<td>675 min.</td>
</tr>
<tr>
<td>Roof sections of exposed top box culverts</td>
<td>675 min.</td>
</tr>
<tr>
<td>Prestressed members</td>
<td>675 min.</td>
</tr>
<tr>
<td>Seal courses</td>
<td>675 min.</td>
</tr>
<tr>
<td>Other portions of structures</td>
<td>590 min.</td>
</tr>
<tr>
<td>Concrete for precast members</td>
<td>590 min., 925 max.</td>
</tr>
</tbody>
</table>

• Whenever the 28-day compressive strength shown on the plans is greater than 3,600 pounds per square inch, the concrete shall be designated by compressive strength. If the plans show a 28-day compressive strength that is 4,000 pounds per square inch or greater, an additional 14 days will be allowed to obtain the specified strength. The 28-day compressive strengths shown on the plans that are 3,600 pounds per square inch or less are shown for design information only and are not a requirement for acceptance of the concrete.
• Concrete designated by compressive strength shall be proportioned such that the concrete will attain the strength shown on the plans or specified in the technical specifications.
• Before using concrete for which the mix proportions have been determined by the Contractor, or in advance of revising those mix proportions, the Contractor shall submit in writing to the Engineer a copy of the mix design.
• Compliance with cementitious material content requirements will be verified in conformance with procedures described in California Test 518 for cement content. For testing purposes, supplementary cementitious material shall be considered to be cement. Batch proportions shall be adjusted as necessary to produce concrete having the specified cementitious material content.
• If any concrete has a cementitious material, portland cement, or supplementary cementitious material content that is less than the minimum required, the concrete shall be
removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place and the Contractor shall pay to the State $0.25 for each pound of cementitious material, portland cement, or supplementary cementitious material that is less than the minimum required. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract. The deductions will not be made unless the difference between the contents required and those actually provided exceeds the batching tolerances permitted by Section 90-5, "Proportioning." No deductions will be made based on the results of California Test 518.

- The requirements of the preceding paragraph shall not apply to minor concrete or commercial quality concrete.

90-2 MATERIALS

90-2.01 CEMENTITIOUS MATERIALS

- Unless otherwise specified, cementitious material shall be either a combination of Type II or Type V portland cement and a supplementary cementitious material, or a blended cement.
- Cementitious materials used in cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same sources and of the same proportions.
- Cementitious materials shall be protected from moisture until used. Sacked cementitious materials shall be piled to permit access for tallying, inspecting, and identifying each shipment.
- Facilities shall be provided to ensure that cementitious materials meeting this Section 90-2.01 are kept separate from other cementitious materials. Sampling cementitious materials shall be in conformance with California Test 125.
- The Contractor shall furnish a Certificate of Compliance for cementitious materials in conformance with the provisions in Section 6-1.07, "Certificates of Compliance." The Certificate of Compliance shall indicate the source by name and location (including country, state, and city). If cementitious material is delivered directly to the job site, the Certificate of Compliance shall be signed by the cementitious material supplier. If the cementitious material is used in ready-mixed concrete or in precast concrete products purchased as such by the Contractor, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product.

90-2.01A CEMENT

- Portland cement shall conform to the requirements in ASTM Designation: C 150 except, using a 10-sample moving average, limestone shall not exceed 2.5 percent. The C₃S content of Type II cement shall not exceed 65 percent.
- Blended cement shall conform to the requirements for Portland Blast-Furnace Slag, Cement Type IS (MS) or Portland-Pozzolan Cement, Type IP (MS) in AASHTO Designation: M 240 and shall be comprised of an intimate and uniform blend of Type II or Type V cement and supplementary cementitious material in an amount conforming to the requirements in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials."
- In addition, blended cement, Type II portland cement, and Type V portland cement shall conform to the following requirements:
A. The cement shall not contain more than 0.60-percent by mass of alkalies, calculated as the percentage of Na₂O plus 0.658 times the percentage of K₂O, when determined by methods as required in AASHTO Designation: T 105;
B. The autoclave expansion shall not exceed 0.50-percent; and
C. Mortar, containing the cement to be used and Ottawa sand, when tested in conformance with California Test 527, shall not expand in water more than 0.010-percent and shall not contract in air more than 0.048-percent, except that when cement is to be used for precast prestressed concrete piling, precast prestressed concrete members, or steam cured concrete products, the mortar shall not contract in air more than 0.053-percent.

• Type III portland cement shall be used only as specified in the technical specifications or with the approval of the Engineer. Type III portland cement shall conform to the additional requirements listed above for Type II portland cement, except when tested in conformance with California Test 527, mortar containing Type III portland cement shall not contract in air more than 0.075-percent.

90-2.01B SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM)
• Fly ash shall conform to the requirements in AASHTO Designation: M 295, Class F, and the following:
  A. Calcium oxide content shall not exceed 10 percent.
  B. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.
  C. Commingling of fly ash from different sources at uncontrolled ratios is permissible only if the following criteria are satisfied:
     1. Sources of fly ash to be commingled shall be on the approved list of materials for use in concrete.
     2. Testing of the commingled product is the responsibility of the fly ash supplier.
     3. Each fly ash's running average of density shall not differ from any other by more than 0.01-pound per cubic inch at the time of commingling.
     4. Each fly ash's running average of loss on ignition shall not differ from any other by more than one percent at the time of commingling.
     5. The final product of commingled fly ash shall conform to the requirement in AASHTO Designation: M 295.

• Raw or calcined natural pozzolans shall conform to the requirements in AASHTO Designation: M 295, Class N and the following requirements:
  A. Calcium oxide content shall not exceed 10 percent.
B. The available alkali, as sodium oxide equivalent, shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311 or the total alkali, as sodium oxide equivalent, shall not exceed 5.0 percent when determined in conformance with the requirements in AASHTO Designation: T 105.

- Ground Granulated Blast Furnace Slag (GGBFS) shall conform to the requirements in AASHTO Designation: M 302, Grade 100 or Grade 120.
- Silica Fume shall conform to the requirements of AASHTO Designation: M 307, with reduction in mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.

**90-2.01C REQUIRED USE OF SUPPLEMENTARY CEMENTITIOUS MATERIALS**

- The amount of portland cement and SCM used in portland cement concrete shall conform to the minimum cementitious material content provisions in Section 90-1.01, "Description," or Section 90-4.05, "Optional Use of Chemical Admixtures," and the following:

  A. If a blended cement conforming to the provisions in Section 90-2.01A, "Cement," is used, the minimum amount of SCM incorporated into the cement shall conform to the provisions in this Section 90-2.01C.
  B. Fly ash or natural pozzolan, silica fume, or GGBFS shall not be used with Type IP or Type IS cements.

- Use of SCMs shall conform to the following:

  A. If fly ash or natural pozzolan is used:

    1. The minimum amount of portland cement shall not be less than 75 percent by weight of the specified minimum cementitious material content.
    2. The minimum amount of fly ash or natural pozzolan shall be:
       a. Fifteen percent by weight of the total amount of cementitious material if the calcium oxide content of fly ash or natural pozzolan is equal to or less than 2 percent by weight;
       b. Twenty-five percent by weight of the total amount of cementitious material if the calcium oxide content of fly ash or natural pozzolan is greater than 2 percent by weight.
    3. The total amount of fly ash or natural pozzolan shall not exceed 35 percent by weight of the total amount of cementitious material to be used in the mix. If Section 90-1.01, "Description," specifies a maximum cementitious material content in pounds per cubic yard, the total weight of portland cement and fly ash or natural pozzolan per cubic yard shall not exceed the specified maximum cementitious material content.
B. If silica fume is used:

1. The amount of silica fume shall not be less than 10 percent by weight of the total amount of cementitious material.
2. The amount of portland cement shall not be less than 75 percent by weight of the specified minimum cementitious material content.
3. If Section 90-1.01, "Description," specifies a maximum cementitious material content in pounds per cubic yard, the total weight of portland cement and silica fume per cubic yard shall not exceed the specified maximum cementitious material content.

C. If GGBFS is used:

1. The minimum amount of GGBFS shall be either:
   a. Forty percent of the total cementitious material to be used, if the aggregates used in the concrete are on the Department's list of "Approved Aggregates For Use in Concrete with Reduced Fly Ash."
   b. No less than 50 percent.
2. The amount of GGBFS shall not exceed 60 percent by weight of the total amount of cementitious materials to be used.

90-2.02 AGGREGATES

- Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.
- The Contractor shall provide safe and suitable facilities, including necessary splitting devices for obtaining samples of aggregates, in conformance with California Test 125.
- Aggregates shall be of such character that it will be possible to produce workable concrete within the limits of water content provided in Section 90-6.06, "Amount of Water and Penetration."
- Aggregates shall have not more than 10 percent loss when tested for soundness in conformance with the requirements in California Test 214. The soundness requirement for fine aggregate will be waived, provided that the durability index, $D_r$, of the fine aggregate is 60 or greater when tested for durability in conformance with California Test 229.
- If the results of any one or more of the Cleanness Value, Sand Equivalent, or aggregate grading tests do not meet the requirements specified for "Operating Range" but all meet the "Contract Compliance" requirements, the placement of concrete shall be suspended at the completion of the current pour until tests or other information indicate that the next material to be used in the work will comply with the requirements specified for "Operating Range."
- If the results of either or both the Cleanness Value and coarse aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete that is represented by the tests shall be removed. However, if the Engineer determines that the concrete is
structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $3.50 per cubic yard for paving concrete and $5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

- If the results of either or both the Sand Equivalent and fine aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete which is represented by the tests shall be removed. However, if the Engineer determines that the concrete is structurally adequate, the concrete may remain in place, and the Contractor shall pay to the State $3.50 per cubic yard for paving concrete and $5.50 per cubic yard for all other concrete for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the Contractor under the contract.

- The 2 preceding paragraphs apply individually to the "Contract Compliance" requirements for coarse aggregate and fine aggregate. When both coarse aggregate and fine aggregate do not conform to the "Contract Compliance" requirements, both paragraphs shall apply. The payments specified in those paragraphs are in addition to any payments made in conformance with the provisions in Section 90-1.01, "Description."

- No single Cleanness Value, Sand Equivalent, or aggregate grading test shall represent more than 300 cubic yards of concrete or one day's pour, whichever is smaller.

- When the source of an aggregate is changed, the Contractor shall adjust the mix proportions and submit in writing to the Engineer a copy of the mix design before using the aggregates.

**90-2.02A COARSE AGGREGATE**

- Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, reclaimed aggregate, crushed air-cooled iron blast furnace slag or combinations thereof. Crushed air-cooled blast furnace slag shall not be used in reinforced or prestressed concrete.

- Reclaimed aggregate is aggregate that has been recovered from plastic concrete by washing away the cementitious material. Reclaimed aggregate shall conform to all aggregate requirements.

- Coarse aggregate shall conform to the following quality requirements:

<table>
<thead>
<tr>
<th>Tests</th>
<th>California Test</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss in Los Angeles Rattler (after 500 revolutions)</td>
<td>211</td>
<td>45% max.</td>
</tr>
<tr>
<td>Cleanness Value Operating Range</td>
<td>227</td>
<td>75 min.</td>
</tr>
<tr>
<td>Cleanness Value Contract Compliance</td>
<td>227</td>
<td>71 min.</td>
</tr>
</tbody>
</table>

- In lieu of the above Cleanness Value requirements, a Cleanness Value "Operating Range" limit of 71, minimum, and a Cleanness Value "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the coarse aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

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A. Coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested in conformance with the requirements in California Test 227; and
B. Prequalification tests performed in conformance with the requirements in California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.02B FINE AGGREGATE
• Fine aggregate shall consist of natural sand, manufactured sand produced from larger aggregate or a combination thereof. Manufactured sand shall be well graded.
• Fine aggregate shall conform to the following quality requirements:

<table>
<thead>
<tr>
<th>Test</th>
<th>California Test</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Impurities</td>
<td>213</td>
<td>Satisfactory*</td>
</tr>
<tr>
<td>Mortar Strengths Relative to Ottawa Sand</td>
<td>515</td>
<td>95%, min.</td>
</tr>
<tr>
<td>Sand Equivalent:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Range</td>
<td>217</td>
<td>75, min.</td>
</tr>
<tr>
<td>Contract Compliance</td>
<td>217</td>
<td>71, min.</td>
</tr>
</tbody>
</table>

  a Fine aggregate developing a color darker than the reference standard color solution may be accepted if it is determined by the Engineer, from mortar strength tests, that a darker color is acceptable.

• In lieu of the above Sand Equivalent requirements, a Sand Equivalent "Operating Range" limit of 71, minimum, and a Sand Equivalent "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the fine aggregate if the Contractor furnishes a Certificate of Compliance, as provided in Section 6-1.07, "Certificates of Compliance," certifying that:

  A. Fine aggregate sampled at the completion of processing at the aggregate production plant had a Sand Equivalent value of not less than 82 when tested by California Test 217; and
  B. Prequalification tests performed in conformance with California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

90-2.03 WATER
• In conventionally reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 1,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO₄, when tested in conformance with California Test 417. In prestressed concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 650 parts per million of chlorides as Cl, when
tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as \( \text{SO}_4 \), when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either: 1) a change in the setting time of cement of more than 25 percent when tested in conformance with the requirements in ASTM Designation: C 191 or ASTM Designation: C 266 or 2) a reduction in the compressive strength of mortar at 14 days of more than 5 percent, when tested in conformance with the requirements in ASTM Designation: C 109, when compared to the results obtained with distilled water or deionized water, tested in conformance with the requirements in ASTM Designation: C 109.

• In nonreinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1,500 parts per million of sulfates as \( \text{SO}_4 \), when tested in conformance with California Test 417.
• In addition to the above provisions, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of the concrete or produce etching of the surface.
• Water reclaimed from mixer wash-out operations may be used in mixing concrete. The water shall not contain coloring agents or more than 300 parts per million of alkalis (\( \text{Na}_2\text{O} + 0.658 \text{K}_2\text{O} \)) as determined on the filtrate. The specific gravity of the water shall not exceed 1.03 and shall not vary more than ±0.010 during a day's operations.

90-2.04 ADMIXTURE MATERIALS

• Admixture materials shall conform to the requirements in the following ASTM Designations:

  A. Chemical Admixtures—ASTM Designation: C 494.

90-3 AGGREGATE GRADINGS

90-3.01 GENERAL

• Before beginning concrete work, the Contractor shall submit in writing to the Engineer the gradation of the primary aggregate nominal sizes that the Contractor proposes to furnish. If a primary coarse aggregate or the fine aggregate is separated into 2 or more sizes, the proposed gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically to indicate one proposed gradation. The proposed gradation shall meet the grading requirements shown in the table in this section, and shall show the percentage passing each of the sieve sizes used in determining the end result.

• The Engineer may waive, in writing, the gradation requirements in this Section 90-3.01 and in Sections 90-3.02, "Coarse Aggregate Grading," 90-3.03, "Fine Aggregate Grading," and 90-3.04, "Combined Aggregate Gradings," if, in the Engineer's opinion, furnishing the gradation is not necessary for the type or amount of concrete work to be constructed.

• Gradations proposed by the Contractor shall be within the following percentage passing limits:
<table>
<thead>
<tr>
<th>Primary Aggregate Nominal Size</th>
<th>Sieve Size</th>
<th>Limits of Proposed Gradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot; x 3/4&quot;</td>
<td>1&quot;</td>
<td>19 - 41</td>
</tr>
<tr>
<td>1&quot; x No. 4</td>
<td>3/4&quot;</td>
<td>52 - 85</td>
</tr>
<tr>
<td>1&quot; x No. 4</td>
<td>3/8&quot;</td>
<td>15 - 38</td>
</tr>
<tr>
<td>1/2&quot; x No. 4</td>
<td>3/8&quot;</td>
<td>40 - 78</td>
</tr>
<tr>
<td>3/8&quot; x No. 8</td>
<td>3/8&quot;</td>
<td>50 - 85</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>No. 16</td>
<td>55 - 75</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>No. 30</td>
<td>34 - 46</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>No. 50</td>
<td>16 - 29</td>
</tr>
</tbody>
</table>

- Should the Contractor change the source of supply, the Contractor shall submit in writing to the Engineer the new gradations before their intended use.

90-3.02 COARSE AGGREGATE GRADING
- The grading requirements for coarse aggregates are shown in the following table for each size of coarse aggregate:

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>Percentage Passing Primary Aggregate Nominal Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>88 - 100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>X ±18</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>0 - 17</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>—</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>0 - 7</td>
</tr>
<tr>
<td>No. 4</td>
<td>—</td>
</tr>
<tr>
<td>No. 8</td>
<td>—</td>
</tr>
</tbody>
</table>

- In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."
- Coarse aggregate for the 1 1/2 inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," shall be furnished in 2 or more primary aggregate nominal sizes. Each primary aggregate nominal size may be separated into 2 sizes and stored separately, provided that the combined material conforms to the grading requirements for that particular primary aggregate nominal size.
- When the one inch, maximum, combined aggregate grading as provided in Section 90-3.04, "Combined Aggregate Gradings," is to be used, the coarse aggregate may be separated into 2 sizes and stored separately, provided that the combined material shall conform to the grading requirements for the 1" x No. 4 primary aggregate nominal size.
90-3.03 FINE AGGREGATE GRADING

- Fine aggregate shall be graded within the following limits:

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>Percentage Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operating Range</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95 - 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>65 - 95</td>
</tr>
<tr>
<td>No. 16</td>
<td>X ±10</td>
</tr>
<tr>
<td>No. 30</td>
<td>X ±9</td>
</tr>
<tr>
<td>No. 50</td>
<td>X ±6</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 - 12</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 8</td>
</tr>
</tbody>
</table>

- In the above table, the symbol X is the gradation that the Contractor proposes to furnish for the specific sieve size as provided in Section 90-3.01, "General."
- In addition to the above required grading analysis, the distribution of the fine aggregate sizes shall be such that the difference between the total percentage passing the No. 16 sieve and the total percentage passing the No. 30 sieve shall be between 10 and 40, and the difference between the percentage passing the No. 30 and No. 50 sieves shall be between 10 and 40.
- Fine aggregate may be separated into 2 or more sizes and stored separately, provided that the combined material conforms to the grading requirements specified in this Section 90-3.03.

90-3.04 COMBINED AGGREGATE GRADINGS

- Combined aggregate grading limits shall be used only for the design of concrete mixes. Concrete mixes shall be designed so that aggregates are combined in proportions that shall produce a mixture within the grading limits for combined aggregates as specified herein.
- The combined aggregate grading, except when otherwise specified in these specifications or the technical specifications, shall be either the 1 1/2 inch, maximum grading, or the 1 inch, maximum grading, at the option of the Contractor.
### Grading Limits of Combined Aggregates

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>1 1/2&quot; Max.</th>
<th>1&quot; Max.</th>
<th>1/2&quot; Max.</th>
<th>3/8&quot; Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1 1/2&quot;</td>
<td>90 - 100</td>
<td>100</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1&quot;</td>
<td>50 - 86</td>
<td>90 - 100</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>45 - 75</td>
<td>55 - 100</td>
<td>100</td>
<td>—</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>—</td>
<td>—</td>
<td>90 - 100</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>38 - 55</td>
<td>45 - 75</td>
<td>55 - 86</td>
<td>50 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>30 - 45</td>
<td>35 - 60</td>
<td>45 - 63</td>
<td>45 - 63</td>
</tr>
<tr>
<td>No. 8</td>
<td>23 - 38</td>
<td>27 - 45</td>
<td>35 - 49</td>
<td>35 - 49</td>
</tr>
<tr>
<td>No. 16</td>
<td>17 - 33</td>
<td>20 - 35</td>
<td>25 - 37</td>
<td>25 - 37</td>
</tr>
<tr>
<td>No. 30</td>
<td>10 - 22</td>
<td>12 - 25</td>
<td>15 - 25</td>
<td>15 - 25</td>
</tr>
<tr>
<td>No. 50</td>
<td>4 - 10</td>
<td>5 - 15</td>
<td>5 - 15</td>
<td>5 - 15</td>
</tr>
<tr>
<td>No. 100</td>
<td>1 - 6</td>
<td>1 - 8</td>
<td>1 - 8</td>
<td>1 - 8</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 3</td>
<td>0 - 4</td>
<td>0 - 4</td>
<td>0 - 4</td>
</tr>
</tbody>
</table>

- Changes from one grading to another shall not be made during the progress of the work unless permitted by the Engineer.

### 90-4 ADMIXTURES

#### 90-4.01 GENERAL
- Admixtures used in portland cement concrete shall conform to and be used in conformance with the provisions in this Section 90-4 and the technical specifications. Admixtures shall be used when specified or ordered by the Engineer and may be used at the Contractor's option as provided herein.
- Chemical admixtures and air-entraining admixtures containing chlorides as Cl in excess of one percent by weight of admixture, as determined by California Test 415, shall not be used.
- Admixtures shall be uniform in properties throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.
- If more than one admixture is used, the admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.
- Chemical admixtures shall be used in conformance with the manufacturer's written recommendations.

#### 90-4.02 MATERIALS
- Admixture materials shall conform to the provisions in Section 90–2.04, "Admixture Materials."

#### 90-4.03 ADMIXTURE APPROVAL
- No admixture brand shall be used in the work unless it is on the Department's current list of approved brands for the type of admixture involved.
- Admixture brands will be considered for addition to the approved list if the manufacturer of the admixture submits to the Transportation Laboratory a sample of the admixture.
accompanied by certified test results demonstrating that the admixture complies with the requirements in the appropriate ASTM Designation and these specifications. The sample shall be sufficient to permit performance of all required tests. Approval of admixture brands will be dependent upon a determination as to compliance with the requirements, based on the certified test results submitted, together with tests the Department may elect to perform.

• If the Contractor proposes to use an admixture of a brand and type on the current list of approved admixture brands, the Contractor shall furnish a Certificate of Compliance from the manufacturer, as provided in Section 6-1.07, "Certificates of Compliance," certifying that the admixture furnished is the same as that previously approved. If a previously approved admixture is not accompanied by a Certificate of Compliance, the admixture shall not be used in the work until the Engineer has had sufficient time to make the appropriate tests and has approved the admixture for use. The Engineer may take samples for testing at any time, whether or not the admixture has been accompanied by a Certificate of Compliance.

90-4.04 REQUIRED USE OF CHEMICAL ADMIXTURES
• If the use of a chemical admixture is specified, the admixture shall be used at the dosage specified, except that if no dosage is specified, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

90-4.05 OPTIONAL USE OF CHEMICAL ADMIXTURES
• The Contractor may use Type A or F, water-reducing; Type B, retarding; or Type D or G, water-reducing and retarding admixtures as described in ASTM Designation: C 494 to conserve cementitious material or to facilitate any concrete construction application subject to the following conditions:
  A. If a water-reducing admixture or a water-reducing and retarding admixture is used, the cementitious material content specified or ordered may be reduced by a maximum of 5 percent by weight, except that the resultant cementitious material content shall be not less than 505 pounds per cubic yard; and
  B. When a reduction in cementitious material content is made, the dosage of admixture used shall be the dosage used in determining approval of the admixture.

• Unless otherwise specified, a Type C accelerating chemical admixture conforming to the requirements in ASTM Designation: C 494, may be used in portland cement concrete. Inclusion in the mix design submitted for approval will not be required provided that the admixture is added to counteract changing conditions that contribute to delayed setting of the portland cement concrete, and the use or change in dosage of the admixture is approved in writing by the Engineer.

90-4.06 REQUIRED USE OF AIR-ENTRAINING ADMIXTURES
• When air-entrainment is specified or ordered by the Engineer, the air-entraining admixture shall be used in amounts to produce a concrete having the specified air content as determined by California Test 504.
90-4.07 OPTIONAL USE OF AIR-ENTRAINING ADMIXTURES

• When air-entrainment has not been specified or ordered by the Engineer, the Contractor will be permitted to use an air-entraining admixture to facilitate the use of any construction procedure or equipment provided that the average air content, as determined by California Test 504, of 3 successive tests does not exceed 4 percent, and no single test value exceeds 5.5 percent. If the Contractor elects to use an air-entraining admixture in concrete for pavement, the Contractor shall so indicate at the time the Contractor designates the source of aggregate.

90-4.08 BLANK

90-4.09 BLANK

90-4.10 PROPORTIONING AND DISPENSING LIQUID ADMIXTURES

• Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers for liquid admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within ±5 percent of the prescribed quantity for each batch. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each measuring unit shall be clearly marked for the type and quantity of admixture.

• Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn slowly by the Engineer.

• If more than one liquid admixture is used in the concrete mix, each liquid admixture shall have a separate measuring unit and shall be dispensed by injecting equipment located in such a manner that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other. When air-entraining admixtures are used in conjunction with other liquid admixtures, the air-entraining admixture shall be the first to be incorporated into the mix, unless it is demonstrated that a different sequence improves performance.

• When automatic proportioning devices are required for concrete pavement, dispensers for liquid admixtures shall operate automatically with the batching control equipment. The dispensers shall be equipped with an automatic warning system in good operating condition that will provide a visible or audible signal at the point at which proportioning operations are controlled when the quantity of admixture measured for each batch of concrete varies from the preselected dosage by more than 5 percent, or when the entire contents of the measuring unit are not emptied from the dispenser into each batch of concrete.

• Unless liquid admixtures are added to premeasured water for the batch, their discharge into the batch shall be arranged to flow into the stream of water so that the admixtures are well dispersed throughout the batch, except that air-entraining admixtures may be dispensed directly into moist sand in the batching bins provided that adequate control of the air content of the concrete can be maintained.
• Liquid admixtures requiring dosages greater than one-half gallon per cubic yard shall be considered to be water when determining the total amount of free water as specified in Section 90-6.06, "Amount of Water and Penetration."

90-4.11 BLANK

90-5 PROPORTIONING

90-5.01 STORAGE OF AGGREGATES
• Aggregates shall be stored or stockpiled in such a manner that separation of coarse and fine particles of each size shall be avoided and the various sizes shall not become intermixed before proportioning.
• Aggregates shall be stored or stockpiled and handled in a manner that prevent contamination by foreign materials. In addition, storage of aggregates at batching or mixing facilities that are erected subsequent to the award of the contract and that furnish concrete to the project shall conform to the following:
  A. Intermingling of the different sizes of aggregates shall be positively prevented. The Contractor shall take the necessary measures to prevent intermingling. The preventive measures may include, but are not necessarily limited to, physical separation of stockpiles or construction of bulkheads of adequate length and height; and
  B. Contamination of aggregates by contact with the ground shall be positively prevented. The Contractor shall take the necessary measures to prevent contamination. The preventive measures shall include, but are not necessarily limited to, placing aggregates on wooden platforms or on hardened surfaces consisting of portland cement concrete, asphalt concrete, or cement treated material.

• In placing aggregates in storage or in moving the aggregates from storage to the weigh hopper of the batching plant, any method that may cause segregation, degradation, or the combining of materials of different gradings that will result in any size of aggregate at the weigh hopper failing to meet the grading requirements, shall be discontinued. Any method of handling aggregates that results in excessive breakage of particles shall be discontinued. The use of suitable devices to reduce impact of falling aggregates may be required by the Engineer.

90-5.02 PROPORTIONING DEVICES
• Weighing, measuring, or metering devices used for proportioning materials shall conform to the requirements in Section 9-1.01, "Measurement of Quantities," and this Section 90-5.02. In addition, automatic weighing systems shall comply with the requirements for automatic proportioning devices in Section 90-5.03A, "Proportioning for Pavement." Automatic devices shall be automatic to the extent that the only manual operation required for proportioning the aggregates, cement, and supplementary cementitious material for one batch of concrete is a single operation of a switch or starter.
• Proportioning devices shall be tested as frequently as the Engineer may deem necessary to ensure their accuracy.
• Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the plant is in operation, the weight of each batch of material shall not vary from the weight designated by the Engineer by more than the tolerances specified herein.

• Equipment for cumulative weighing of aggregate shall have a zero tolerance of ±0.5 percent of the designated total batch weight of the aggregate. For systems with individual weigh hoppers for the various sizes of aggregate, the zero tolerance shall be ±0.5 percent of the individual batch weight designated for each size of aggregate. Equipment for cumulative weighing of cement and supplementary cementitious material shall have a zero tolerance of ±0.5 percent of the designated total batch weight of the cement and supplementary cementitious material. Equipment for weighing cement or supplementary cementitious material separately shall have a zero tolerance of ±0.5 percent of their designated individual batch weights. Equipment for measuring water shall have a zero tolerance of ±0.5 percent of its designated weight or volume.

• The weight indicated for any batch of material shall not vary from the preselected scale setting by more than the following:

  A. Aggregate weighed cumulatively shall be within 1.0 percent of the designated total batch weight of the aggregate. Aggregates weighed individually shall be within 1.5 percent of their respective designated batch weights; and

  B. Cement shall be 99 to 102 percent of its designated batch weight. When weighed individually, supplementary cementitious material shall be 99 to 102 percent of its designated batch weight. When supplementary cementitious material and cement are permitted to be weighed cumulatively, cement shall be weighed first to 99 to 102 percent of its designated batch weight, and the total for cement and supplementary cementitious material shall be 99 to 102 percent of the sum of their designated batch weights; and

  C. Water shall be within 1.5 percent of its designated weight or volume.

• Each scale graduation shall be approximately 0.001 of the total capacity of the scale. The capacity of scales for weighing cement, supplementary cementitious material, or cement plus supplementary cementitious material and aggregates shall not exceed that of commercially available scales having single graduations indicating a weight not exceeding the maximum permissible weight variation above, except that no scale shall be required having a capacity of less than 1,000 pounds, with one pound graduations.

**90-5.03 PROPORTIONING**

• Proportioning shall consist of dividing the aggregates into the specified sizes, each stored in a separate bin, and combining them with cementitious material and water as provided in these specifications. Aggregates shall be proportioned by weight.

• At the time of batching, aggregates shall have been dried or drained sufficiently to result in a stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing. In no event shall the free moisture content of the fine aggregate at the time of batching exceed 8 percent of its...
saturated, surface-dry weight.

- Should separate supplies of aggregate material of the same size group, but of different
  moisture content or specific gravity or surface characteristics affecting workability, be available
  at the proportioning plant, withdrawals shall be made from one supply exclusively and the
  materials therein completely exhausted before starting upon another.
- Bulk Type IP (MS) cement shall be weighed in an individual hopper and shall be kept
  separate from the aggregates until the ingredients are released for discharge into the mixer.
- Bulk cement and supplementary cementitious material may be weighed in separate,
  individual weigh hoppers or may be weighed in the same weigh hopper and shall be kept
  separate from the aggregates until the ingredients are released for discharge into the mixer. If
  the cement and supplementary cementitious material are weighed cumulatively, the cement shall
  be weighed first.
- If cement and supplementary cementitious material are weighed in separate weigh
  hoppers, the weigh systems for the proportioning of the aggregate, the cement, and the
  supplementary cementitious material shall be individual and distinct from all other weigh
  systems. Each weigh system shall be equipped with a hopper, a lever system, and an indicator to
  constitute an individual and independent material-weighing device. The cement and the
  supplementary cementitious material shall be discharged into the mixer simultaneously with the
  aggregate.
- The scales and weigh hoppers for bulk weighing cement, supplementary cementitious
  material, or cement plus supplementary cementitious material shall be separate and distinct from
  the aggregate weighing equipment.
- For batches of one cubic yard or more, the batching equipment shall conform to one of
  the following combinations:
  
  A. Separate boxes and separate scale and indicator for weighing each size of aggregate.
  B. Single box and scale indicator for all aggregates.
  C. Single box or separate boxes and automatic weighing mechanism for all aggregates.

- In order to check the accuracy of batch weights, the gross weight and tare weight of batch
  trucks, truck mixers, truck agitators, and non-agitating hauling equipment shall be determined
  when ordered by the Engineer. The equipment shall be weighed on scales designated by the
  Engineer.

90-6 MIXING AND TRANSPORTING

90-6.01 GENERAL

- Concrete shall be mixed in mechanically operated mixers, except that when permitted by
  the Engineer, batches not exceeding 1/3 cubic yard may be mixed by hand methods in
  conformance with the provisions in Section 90-6.05, "Hand-Mixing."
- Equipment having components made of aluminum or magnesium alloys that would have
  contact with plastic concrete during mixing, transporting, or pumping of portland cement
  concrete shall not be used.
- Concrete shall be homogeneous and thoroughly mixed, and there shall be no lumps or
evidence of undispersed cementitious material.

- Uniformity of concrete mixtures will be determined by differences in penetration as determined by California Test 533, or slump as determined by ASTM Designation: C 143, and by variations in the proportion of coarse aggregate as determined by California Test 529.  
- When the mix design specifies a penetration value, the difference in penetration, determined by comparing penetration tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed 1/2-inch.  When the mix design specifies a slump value, the difference in slump, determined by comparing slump tests on 2 samples of mixed concrete from the same batch or truck mixer load, shall not exceed the values given in the table below.  Variation in the proportion of coarse aggregate will be determined by comparing the results of tests of 2 samples of mixed concrete from the same batch or truck mixer load and the difference between the 2 results shall not exceed 170 pounds per cubic yard of concrete.

<table>
<thead>
<tr>
<th>Average Slump</th>
<th>Maximum Permissible Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>4&quot; to 6&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>Greater than 6&quot; to 9&quot;</td>
<td>2&quot;</td>
</tr>
</tbody>
</table>

- The Contractor shall furnish samples of the freshly mixed concrete and provide satisfactory facilities for obtaining the samples.

**90-6.02 MACHINE MIXING**

- Concrete mixers may be of the revolving drum or the revolving blade type, and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. Mixers and agitators that have an accumulation of hard concrete or mortar shall not be used.
- The temperature of mixed concrete, immediately before placing, shall be not less than 50° F or more than 90° F. Aggregates and water shall be heated or cooled as necessary to produce concrete within these temperature limits. Neither aggregates nor mixing water shall be heated to exceed 150° F. If ice is used to cool the concrete, discharge of the mixer will not be permitted until all ice is melted.
- The batch shall be so charged into the mixer that some water will enter in advance of cementitious materials and aggregates. All water shall be in the drum by the end of the first one-fourth of the specified mixing time.
- Cementitious materials shall be batched and charged into the mixer by means that will not result either in loss of cementitious materials due to the effect of wind, in accumulation of cementitious materials on surfaces of conveyors or hoppers, or in other conditions that reduce or vary the required quantity of cementitious material in the concrete mixture.
- Paving and stationary mixers shall be operated with an automatic timing device. The timing device and discharge mechanism shall be interlocked so that during normal operation no part of the batch will be discharged until the specified mixing time has elapsed.
- The total elapsed time between the intermingling of damp aggregates and all cementitious materials and the start of mixing shall not exceed 30 minutes.
• The size of batch shall not exceed the manufacturer's guaranteed capacity.
• When producing concrete for pavement or base, suitable batch counters shall be installed and maintained in good operating condition at job site batching plants and stationary mixers. The batch counters shall indicate the exact number of batches proportioned and mixed.
• Concrete shall be mixed and delivered to the job site by means of one of the following combinations of operations:

  A. Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in nonagitating hauling equipment (central-mixed concrete).
  B. Mixed partially in a stationary mixer, and the mixing completed in a truck mixer (shrink-mixed concrete).
  C. Mixed completely in a truck mixer (transit-mixed concrete).
  D. Mixed completely in a paving mixer.

• Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.
• Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified.
• When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed will be allowed for partial mixing in a central plant.

90-6.03 TRANSPORTING MIXED CONCRETE

• Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place, and provided the mixed concrete after hauling to the delivery point conforms to the provisions in Section 90-6.01, "General."
• Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity and shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.
• Bodies of nonagitating hauling equipment shall be constructed so that leakage of the concrete mix, or any part thereof, will not occur at any time.
• Concrete hauled in open-top vehicles shall be protected during hauling against rain or against exposure to the sun for more than 20 minutes when the ambient temperature exceeds 75° F.
• No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point, unless authorized by the Engineer. If the Engineer authorizes
additional water to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.

- The rate of discharge of mixed concrete from truck mixer-agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.
- If a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1.5 hours or before 250 revolutions of the drum or blades, whichever occurs first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or if the temperature of the concrete is 85° F or above, the time allowed may be less than 1.5 hours. If an admixture is used to retard the set time, the temperature of the concrete shall not exceed 85° F, the time limit shall be 2 hours, and the revolution limitation shall be 300.
- If nonagitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85° F or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.
- Each load of concrete delivered at the job site shall be accompanied by a weighmaster certificate showing the mix identification number, nonrepeating load number, date and time at which the materials were batched, the total amount of water added to the load, and for transit-mixed concrete, the reading of the revolution counter at the time the truck mixer is charged with cement. This weighmaster certificate shall also show the actual scale weights (pounds) for the ingredients batched. Theoretical or target batch weights shall not be used as a substitute for actual scale weights.
- Weighmaster certificates shall be provided in printed form, or if approved by the Engineer, the data may be submitted in electronic media. Electronic media shall be presented in a tab-delimited format on a 3 1/2-inch diskette with a capacity of at least 1.4 megabytes. Captured data, for the ingredients represented by each batch shall be "line feed, carriage return" (LFCR) and "one line, separate record" with allowances for sufficient fields to satisfy the amount of data required by these specifications.
- The Contractor may furnish a weighmaster certificate accompanied by a separate certificate that lists the actual batch weights or measurements for a load of concrete provided that both certificates are imprinted with the same nonrepeating load number that is unique to the contract and delivered to the jobsite with the load.
- Weighmaster certificates furnished by the Contractor shall conform to the provisions in Section 9-1.01, "Measurement of Quantities."

90-6.04 TIME OR AMOUNT OF MIXING

- Mixing of concrete in paving or stationary mixers shall continue for the required mixing time after all ingredients, except water and admixture, if added with the water, are in the mixing compartment of the mixer before any part of the batch is released. Transfer time in multiple drum mixers shall not be counted as part of the required mixing time.
- The required mixing time, in paving or stationary mixers, of concrete used for concrete structures, except minor structures, shall be not less than 90 seconds or more than 5 minutes,
except that when directed by the Engineer in writing, the requirements of the following paragraph shall apply.

• The required mixing time, in paving or stationary mixers, except as provided in the preceding paragraph, shall be not less than 50 seconds or more than 5 minutes.

• The minimum required revolutions at the mixing speed for transit-mixed concrete shall not be less than that recommended by the mixer manufacturer, but in no case shall the number of revolutions be less than that required to consistently produce concrete conforming to the provisions for uniformity in Section 90-6.01, "General."

• When a high range water-reducing admixture is added to the concrete at the job site, the total number of revolutions shall not exceed 300.

90-6.05 HAND-MIXING

• Hand-mixed concrete shall be made in batches of not more than 1/3 cubic yard and shall be mixed on a watertight, level platform. The proper amount of coarse aggregate shall be measured in measuring boxes and spread on the platform and the fine aggregate shall be spread on this layer, the 2 layers being not more than one foot in total depth. On this mixture shall be spread the dry cementitious materials and the whole mass turned no fewer than 2 times dry; then sufficient clean water shall be added, evenly distributed, and the whole mass again turned no fewer than 3 times, not including placing in the carriers or forms.

90-6.06 AMOUNT OF WATER AND PENETRATION

• The amount of water used in concrete mixes shall be regulated so that the penetration of the concrete as determined by California Test 533 or the slump of the concrete as determined by ASTM Designation: C 143 is within the nominal values shown in the following table. When the penetration or slump of the concrete is found to exceed the nominal values listed, the mixture of subsequent batches shall be adjusted to reduce the penetration or slump to a value within the nominal range shown. Batches of concrete with a penetration or slump exceeding the maximum values listed shall not be used in the work. If Type F or Type G chemical admixtures are added to the mix, the penetration requirements shall not apply and the slump shall not exceed 9 inches after the chemical admixtures are added.

<table>
<thead>
<tr>
<th>Type of Work</th>
<th>Nominal Penetration (inches)</th>
<th>Nominal Slump (inches)</th>
<th>Maximum Penetration (inches)</th>
<th>Maximum Slump (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Pavement</td>
<td>0 - 1</td>
<td>—</td>
<td>1 1/2</td>
<td>—</td>
</tr>
<tr>
<td>Non-reinforced concrete facilities</td>
<td>0 - 1 1/2</td>
<td>—</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>Reinforced concrete structures</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Sections over 12 inches thick</td>
<td>0 - 1 1/2</td>
<td>—</td>
<td>2 1/2</td>
<td>—</td>
</tr>
<tr>
<td>Sections 12 inches thick or less</td>
<td>0 - 2</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Concrete placed under water</td>
<td>—</td>
<td>6 - 8</td>
<td>—</td>
<td>9</td>
</tr>
<tr>
<td>Cast-in-place concrete piles</td>
<td>2 1/2 - 3 1/2</td>
<td>5 - 7</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

• The amount of free water used in concrete shall not exceed 310 pounds per cubic yard, plus 20 pounds for each required 100 pounds of cementitious material in excess of 550 pounds.

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per cubic yard.
• The term free water is defined as the total water in the mixture minus the water absorbed by the aggregates in reaching a saturated surface-dry condition.
• If there are adverse or difficult conditions that affect the placing of concrete, the above specified penetration and free water content limitations may be exceeded providing the Contractor is granted permission by the Engineer in writing to increase the cementitious material content per cubic yard of concrete. The increase in water and cementitious material shall be at a ratio not to exceed 30 pounds of water per added 100 pounds of cementitious material per cubic yard. Full compensation for additional cementitious material and water added under these conditions shall be considered as included in the contract price paid for the concrete work involved and no additional compensation will be allowed therefor.
• The equipment for supplying water to the mixer shall be constructed and arranged so that the amount of water added can be measured accurately. Any method of discharging water into the mixer for a batch shall be accurate within 1.5 percent of the quantity of water required to be added to the mix for any position of the mixer. Tanks used to measure water shall be designed so that water cannot enter while water is being discharged into the mixer and discharge into the mixer shall be made rapidly in one operation without dribbling. All equipment shall be arranged so as to permit checking the amount of water delivered by discharging into measured containers.

90-7 CURING CONCRETE

90-7.01 METHODS OF CURING
• Newly placed concrete shall be cured by the methods specified in this Section 90-7.01 and the technical specifications.

90-7.01A WATER METHOD
• The concrete shall be kept continuously wet by the application of water for a minimum curing period of 7 days after the concrete has been placed.
• Cotton mats, rugs, carpets, or earth or sand blankets may be used as a curing medium to retain the moisture during the curing period.
• If a curing medium consisting of cotton mats, rugs, carpets, polyethylene sheeting, polyethylene sheeting on burlap, or earth or sand blankets is to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing media.
• At the option of the Contractor, a curing medium consisting of white opaque polyethylene sheeting extruded onto burlap may be used to cure concrete structures. The polyethylene sheeting shall have a minimum thickness of 4-mil, and shall be extruded onto 10-ounce burlap.
• At the option of the Contractor, a curing medium consisting of polyethylene sheeting may be used to cure concrete columns. The polyethylene sheeting shall have a minimum
thickness of 10-mil achieved in a single layer of material.
• If the Contractor chooses to use polyethylene sheeting or polyethylene sheeting on burlap as a curing medium, these media and any joints therein shall be secured as necessary to provide moisture retention and shall be within 3 inches of the concrete at all points along the surface being cured. When these media are used, the temperature of the concrete shall be monitored during curing. If the temperature of the concrete cannot be maintained below 140° F, use of these curing media shall be disallowed.
• When concrete bridge decks and flat slabs are to be cured without the use of a curing medium, the entire surface of the bridge deck or slab shall be kept damp by the application of water with an atomizing nozzle as specified above, until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

90-7.01B CURING COMPOUND METHOD
• Surfaces of the concrete that are exposed to the air shall be sprayed uniformly with a curing compound.

• Curing compounds to be used shall be as follows:
  1. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B, except the resin type shall be poly-alpha-methylstyrene.
  2. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class B.
  3. Pigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 2, Class A.
  4. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class B.
  5. Nonpigmented curing compound conforming to the requirements in ASTM Designation: C 309, Type 1, Class A.
  6. Nonpigmented curing compound with fugitive dye conforming to the requirements in ASTM Designation: C 309, Type 1-D, Class A.

• The infrared scan for the dried vehicle from curing compound (1) shall match the infrared scan on file at the Transportation Laboratory.
• The loss of water for each type of curing compound, when tested in conformance with the requirements in California Test 534, shall not be more than 0.28-pounds per square yard in 24 hours.
• The curing compound to be used will be specified elsewhere in these specifications or in the technical specifications.
• If the use of curing compound is required or permitted elsewhere in these specifications or in the technical specifications and no specific kind is specified, any of the curing compounds listed above may be used.
• Curing compound shall be applied at a nominal rate of one gallon per 150 square feet, unless otherwise specified.
At any point, the application rate shall be within ±50 square feet per gallon of the nominal rate specified, and the average application rate shall be within ±25 square feet per gallon of the nominal rate specified when tested in conformance with the requirements in California Test 535. Runs, sags, thin areas, skips, or holidays in the applied curing compound shall be evidence that the application is not satisfactory.

Curing compounds shall be applied using power operated spray equipment. The power operated spraying equipment shall be equipped with an operational pressure gage and a means of controlling the pressure. Hand spraying of small and irregular areas that are not reasonably accessible to mechanical spraying equipment, in the opinion of the Engineer, may be permitted.

The curing compound shall be applied to the concrete following the surface finishing operation, immediately before the moisture sheen disappears from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any drying or cracking of the surface, application of water with an atomizing nozzle as specified in Section 90-7.01A, "Water Method," shall be started immediately and shall be continued until application of the compound is resumed or started; however, the compound shall not be applied over any resulting freestanding water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures and 72 hours in the case of pavement, the damaged portion shall be repaired immediately with additional compound.

At the time of use, compounds containing pigments shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. A paddle shall be used to loosen all settled pigment from the bottom of the container, and a power driven agitator shall be used to disperse the pigment uniformly throughout the vehicle.

Agitation shall not introduce air or other foreign substance into the curing compound.

The manufacturer shall include in the curing compound the necessary additives for control of sagging, pigment settling, leveling, de-emulsification, or other requisite qualities of a satisfactory working material. Pigmented curing compounds shall be manufactured so that the pigment does not settle badly, does not cake or thicken in the container, and does not become granular or curdled. Settlement of pigment shall be a thoroughly wetted, soft, mushy mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sideways manual motion of the paddle across the bottom of the container, to form a smooth uniform product of the proper consistency.

Curing compounds shall remain sprayable at temperatures above 40° F and shall not be diluted or altered after manufacture.

The curing compound shall be packaged in clean 274-gallon totes, 55-gallon barrels or 5-gallon pails shall be supplied from a suitable storage tank located at the jobsite. The containers shall comply with "Title 49, Code of Federal Regulations, Hazardous Materials Regulations." The 274-gallon totes and the 55-gallon barrels shall have removable lids and airtight fasteners. The 5-gallon pails shall be round and have standard full open head and bail. Lids with bungholes will not be permitted. Settling or separation of solids in containers, except tanks, must be completely redispersed with low speed mixing prior to use, in conformance with these specifications and the manufacturer's recommendations. Mixing shall be accomplished either manually by use of a paddle or by use of a mixing blade driven by a drill motor, at low speed. Mixing blades shall be the type used for mixing paint. On-site storage tanks shall be kept...
clean and free of contaminants. Each tank shall have a permanent system designed to completely redisperse settled material without introducing air or other foreign substances.

• Steel containers and lids shall be lined with a coating that will prevent destructive action by the compound or chemical agents in the air space above the compound. The coating shall not come off the container or lid as skins. Containers shall be filled in a manner that will prevent skinning. Plastic containers shall not react with the compound.

• Each container shall be labeled with the manufacturer's name, kind of curing compound, batch number, volume, date of manufacture, and volatile organic compound (VOC) content. The label shall also warn that the curing compound containing pigment shall be well stirred before use. Precautions concerning the handling and the application of curing compound shall be shown on the label of the curing compound containers in conformance with the Construction Safety Orders and General Industry Safety Orders of the State.

• Containers of curing compound shall be labeled to indicate that the contents fully comply with the rules and regulations concerning air pollution control in the State.

• When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

• Curing compound will be sampled by the Engineer at the source of supply, at the job site, or at both locations.

• Curing compound shall be formulated so as to maintain the specified properties for a minimum of one year. The Engineer may require additional testing before use to determine compliance with these specifications if the compound has not been used within one year or whenever the Engineer has reason to believe the compound is no longer satisfactory.

• Tests will be conducted in conformance with the latest ASTM test methods and methods in use by the Transportation Laboratory.

90-7.01C WATERPROOF MEMBRANE METHOD

• The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed, until the concrete has set, after which the curing membrane, shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

• Sheeting material for curing concrete shall conform to the requirements in AASHTO Designation: M 171 for white reflective materials.

• The sheeting material shall be fabricated into sheets of such width as to provide a complete cover for the entire concrete surface. Joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 0.33-foot.

• The sheets shall be securely weighted down by placing a bank of earth on the edges of the sheets or by other means satisfactory to the Engineer.

• Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly cemented into place.

• Sections of membrane that have lost their waterproof qualities or have been damaged to

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such an extent as to render them unfit for curing the concrete shall not be used.

**90-7.01D FORMS-IN-PLACE METHOD**

- Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 20 inches in least dimension the forms shall remain in place for a minimum period of 5 days.
- Joints in the forms and the joints between the end of forms and concrete shall be kept moisture tight during the curing period. Cracks in the forms and cracks between the forms and the concrete shall be resealed by methods subject to the approval of the Engineer.

**90-7.02 CURING PAVEMENT**

- The entire exposed area of the pavement, including edges, shall be cured by the waterproof membrane method, or curing compound method using curing compound (1) or (2) as the Contractor may elect. Should the side forms be removed before the expiration of 72 hours following the start of curing, the exposed pavement edges shall also be cured. If the pavement is cured by means of the curing compound method, the sawcut and all portions of the curing compound that have been disturbed by sawing operations shall be restored by spraying with additional curing compound.
- Curing shall commence as soon as the finishing process provided in Section 40-1.10, "Final Finishing," has been completed. The method selected shall conform to the provisions in Section 90-7.01, "Methods of Curing."
- When the curing compound method is used, the compound shall be applied to the entire pavement surface by mechanical sprayers. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator that provides for continual agitation of the curing compound during the time of application. The spray shall be adequately protected against wind, and the nozzles shall be so oriented or moved mechanically transversely as to result in the minimum specified rate of coverage being applied uniformly on exposed faces. Hand spraying of small and irregular areas, and areas inaccessible to mechanical spraying equipment, in the opinion of the Engineer, will be permitted. When the ambient air temperature is above 60° F, the Contractor shall fog the surface of the concrete with a fine spray of water as specified in Section 90-7.01A, "Water Method." The surface of the pavement shall be kept moist between the hours of 10:00 a.m. and 4:30 p.m. on the day the concrete is placed. However, the fogging done after the curing compound has been applied shall not begin until the compound has set sufficiently to prevent displacement. Fogging shall be discontinued if ordered in writing by the Engineer.

**90-7.03 CURING STRUCTURES**

- Newly placed concrete for cast-in-place structures, other than highway bridge decks, shall be cured by the water method, the forms-in-place method, or, as permitted herein, by the curing compound method, in conformance with the provisions in Section 90-7.01, "Methods of Curing."
- The curing compound method using a pigmented curing compound may be used on
concrete surfaces of construction joints, surfaces that are to be buried underground, and surfaces where only ordinary surface finish is to be applied and on which a uniform color is not required and that will not be visible from a public traveled way. If the Contractor elects to use the curing compound method on the bottom slab of box girder spans, the curing compound shall be curing compound (1).

- The top surface of highway bridge decks shall be cured by both the curing compound method and the water method. The curing compound shall be curing compound (1).
- Concrete surfaces of minor structures, as defined in Section 51-1.02, "Minor Structures," shall be cured by the water method, the forms-in-place method or the curing compound method.
- When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surfaces being cured by the curing compound method or by the forms-in-place method, until the Engineer determines that a cooling effect is no longer required. Application of water for this purpose will be paid for as extra work as provided in Section 4-1.03D, "Extra Work."

90-7.04 CURING PRECAST CONCRETE MEMBERS

- Precast concrete members shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing." Curing shall be provided for the minimum time specified for each method or until the concrete reaches its design strength, whichever is less. Steam curing may also be used for precast members and shall conform to the following provisions:

A. After placement of the concrete, members shall be held for a minimum 4-hour presteaming period. If the ambient air temperature is below 50°F, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 50°F and 90°F.

B. To prevent moisture loss on exposed surfaces during the presteaming period, members shall be covered as soon as possible after casting or the exposed surfaces shall be kept wet by fog spray or wet blankets.

C. Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good repair and secured in such a manner as to prevent the loss of steam and moisture.

D. Steam at the jets shall be at low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 40°F per hour. The curing temperature throughout the enclosure shall not exceed 150°F and shall be maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature is representative of the average temperature of the enclosure.

E. Temperature recording devices that will provide an accurate, continuous, permanent record of the curing temperature shall be provided. A minimum of one temperature
recording device per 200 feet of continuous bed length will be required for checking temperature.

F. Members in pretension beds shall be detensioned immediately after the termination of steam curing while the concrete and forms are still warm, or the temperature under the enclosure shall be maintained above 60° F until the stress is transferred to the concrete.

G. Curing of precast concrete will be considered completed after termination of the steam curing cycle.

**90-7.07 CURING MISCELLANEOUS CONCRETE WORK**
- Exposed surfaces of curbs shall be cured by pigmented curing compounds as specified in Section 90-7.01B, "Curing Compound Method."
- Concrete sidewalks, gutter depressions, island paving, curb ramps, driveways, and other miscellaneous concrete areas shall be cured in conformance with any of the methods specified in Section 90-7.01, "Methods of Curing."
- Shotcrete shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."
- Mortar and grout shall be cured by keeping the surface damp for 3 days.
- After placing, the exposed surfaces of sign structure foundations, including pedestal portions, if constructed, shall be cured for at least 72 hours by spraying with water, by a moist earth blanket, or by any of the methods provided in Section 90-7.01, "Methods of Curing."

**90-8 PROTECTING CONCRETE**

**90-8.01 GENERAL**
- In addition to the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials," the Contractor shall protect concrete as provided in this Section 90-8. If required by the Engineer, the Contractor shall submit a written outline of the proposed methods for protecting the concrete.
- The Contractor shall protect concrete from damage from any cause, which shall include, but not be limited to: rain, heat, cold, wind, Contractor's actions, and actions of others.
- Concrete shall not be placed on frozen or ice-coated ground or subgrade nor on ice-coated forms, reinforcing steel, structural steel, conduits, precast members, or construction joints.
- Under rainy conditions, placing of concrete shall be stopped before the quantity of surface water is sufficient to damage surface mortar or cause a flow or wash of the concrete surface, unless the Contractor provides adequate protection against damage.
- Concrete that has been frozen or damaged by other causes, as determined by the Engineer, shall be removed and replaced by the Contractor at the Contractor's expense.

**90-8.02 PROTECTING CONCRETE STRUCTURES**
- Structure concrete and shotcrete used as structure concrete shall be maintained at a temperature of not less than 45° F for 72 hours after placing and at not less than 40° F for an additional 4 days.
90-9 COMPRRESSIVE STRENGTH

90-9.01 GENERAL

- Concrete compressive strength requirements consist of a minimum strength that shall be attained before various loads or stresses are applied to the concrete and, for concrete designated by strength, a minimum strength at the age of 28 days or at the age otherwise allowed in Section 90-1.01, "Description." The various strengths required are specified in these specifications or the technical specifications or are shown on the plans.
- The compressive strength of concrete will be determined from test cylinders that have been fabricated from concrete sampled in conformance with the requirements of California Test 539. Test cylinders will be molded and initially field cured in conformance with California Test 540. Test cylinders will be cured and tested after receipt at the testing laboratory in conformance with the requirements of California Test 521. A strength test shall consist of the average strength of 2 cylinders fabricated from material taken from a single load of concrete, except that, if any cylinder should show evidence of improper sampling, molding, or testing, that cylinder shall be discarded and the strength test shall consist of the strength of the remaining cylinder.
- When concrete compressive strength is specified as a prerequisite to applying loads or stresses to a concrete structure or member, test cylinders for other than steam cured concrete will be cured in conformance with Method 1 of California Test 540. The compressive strength of concrete determined for these purposes will be evaluated on the basis of individual tests.
- When concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete strength to be used as a basis for acceptance of other than steam cured concrete will be determined from cylinders cured in conformance with Method 1 of California Test 540. If the result of a single compressive strength test at the maximum age specified or allowed is below the specified strength but is 95 percent or more of the specified strength, the Contractor shall make corrective changes, subject to approval of the Engineer, in the mix proportions or in the concrete fabrication procedures, before placing additional concrete, and shall pay to the State $10 for each in-place cubic yard of concrete represented by the deficient test. If the result of a single compressive strength test at the maximum age specified or allowed is below 95 percent of the specified strength, but is 85 percent or more of the specified strength, the Contractor shall make the corrective changes specified above, and shall pay to the State $15 for each in-place cubic yard of concrete represented by the deficient test. In addition, such corrective changes shall be made when the compressive strength of concrete tested at 7 days indicates, in the judgment of the Engineer, that the concrete will not attain the required compressive strength at the maximum age specified or allowed. Concrete represented by a single test that indicates a compressive strength of less than 85 percent of the specified 28-day compressive strength will be rejected in conformance with the provisions in Section 6-1.04, "Defective Materials."
- If the test result indicates that the compressive strength at the maximum curing age specified or allowed is below the specified strength, but is 85 percent or more of the specified strength, payments to the State as required above shall be made, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength...
of the concrete placed in the work meets or exceeds the specified 28-day compressive strength. If the test result indicates a compressive strength at the maximum curing age specified or allowed below 85 percent, the concrete represented by that test will be rejected, unless the Contractor, at the Contractor's expense, obtains and submits evidence acceptable to the Engineer that the strength and quality of the concrete placed in the work are acceptable. If the evidence consists of tests made on cores taken from the work, the cores shall be obtained and tested in conformance with the requirements in ASTM Designation: C 42.

- No single compressive strength test shall represent more than 320 cubic yards.
- If a precast concrete member is steam cured, the compressive strength of the concrete will be determined from test cylinders that have been handled and stored in conformance with Method 3 of California Test 540. The compressive strength of steam cured concrete will be evaluated on the basis of individual tests representing specific portions of production. If the concrete is designated by 28-day compressive strength rather than by cementitious material content, the concrete shall be considered to be acceptable whenever its compressive strength reaches the specified 28-day compressive strength provided that strength is reached in not more than the maximum number of days specified or allowed after the member is cast.

- When concrete is specified by compressive strength, prequalification of materials, mix proportions, mixing equipment, and procedures proposed for use will be required prior to placement of the concrete. Prequalification shall be accomplished by the submission of acceptable certified test data or trial batch reports by the Contractor. Prequalification data shall be based on the use of materials, mix proportions, mixing equipment, procedures, and size of batch proposed for use in the work.

- Certified test data, in order to be acceptable, shall indicate that not less than 90 percent of at least 20 consecutive tests exceed the specified strength at the maximum number of cure days specified or allowed, and none of those tests are less than 95 percent of specified strength. Strength tests included in the data shall be the most recent tests made on concrete of the proposed mix design and all shall have been made within one year of the proposed use of the concrete.

- Trial batch test reports, in order to be acceptable, shall indicate that the average compressive strength of 5 consecutive concrete cylinders, taken from a single batch, at not more than 28 days (or the maximum age allowed) after molding shall be at least 580 pounds per square inch greater than the specified 28-day compressive strength, and no individual cylinder shall have a strength less than the specified strength at the maximum age specified or allowed. Data contained in the report shall be from trial batches that were produced within one year of the proposed use of specified strength concrete in the project. Whenever air-entrainment is required, the air content of trial batches shall be equal to or greater than the air content specified for the concrete without reduction due to tolerances.

- Tests shall be performed in conformance with either the appropriate California Test methods or the comparable ASTM test methods. Equipment employed in testing shall be in good condition and shall be properly calibrated. If the tests are performed during the life of the contract, the Engineer shall be notified sufficiently in advance of performing the tests in order to witness the test procedures.
• The certified test data and trial batch test reports shall include the following information:
  A. Date of mixing.
  B. Mixing equipment and procedures used.
  C. The size of batch in cubic yards and the weight, type, and source of all ingredients used.
  D. Penetration or slump (if the concrete will be placed under water or placed in cast-in-place concrete piles) of the concrete.
  E. The air content of the concrete if an air-entraining admixture is used.
  F. The age at time of testing and strength of all concrete cylinders tested.

• Certified test data and trial batch test reports shall be signed by an official of the firm that performed the tests.
• When approved by the Engineer, concrete from trial batches may be used in the work at locations where concrete of a lower quality is required and the concrete will be paid for as the type or class of concrete required at that location.
• After materials, mix proportions, mixing equipment, and procedures for concrete have been prequalified for use, additional prequalification by testing of trial batches will be required prior to making changes that, in the judgment of the Engineer, could result in a strength of concrete below that specified.
• The Contractor's attention is directed to the time required to test trial batches and the Contractor shall be responsible for production of trial batches at a sufficiently early date so that the progress of the work is not delayed.
• When precast concrete members are manufactured at the plant of an established manufacturer of precast concrete members, the mix proportions of the concrete shall be determined by the Contractor, and a trial batch and prequalification of the materials, mix proportions, mixing equipment, and procedures will not be required.

3.2 GENERAL

Engineering Fabric

Engineering fabrics shall conform to the provisions in Section 88, "Engineering Fabrics," of the Standard Specifications and these technical specifications.

Filter fabric for this project shall be ultraviolet (UV) ray protected.

Portland Cement Concrete

Portland cement concrete shall conform to the provisions in Section 90, "Portland Cement Concrete," of the Standard Specifications and these technical specifications.

The Department of Transportation maintains a list of sources of fine and coarse aggregate that have been approved for use with a reduced amount of supplementary cementitious material in
the total amount of cementitious material to be used. A source of aggregate will be considered for addition to the approved list if the producer of the aggregate submits to the Transportation Laboratory certified test results from a qualified testing laboratory that verify the aggregate complies with the requirements. Before the testing starts, the aggregate test shall be registered with the Department of Transportation. A registration number can be obtained by calling (916) 227-7228. The registration number shall be used as the identification for the aggregate sample in correspondence with the Department. Upon request, a split of the tested sample shall be provided to the Department of Transportation. Approval of aggregate will depend upon compliance with the specifications, based on the certified test results submitted, together with any replicate testing the Department may elect to perform. Approval will expire 3 years from the date the most recent registered and evaluated sample was collected from the aggregate source.

Qualified testing laboratories shall conform to the following requirements:

1. Laboratories performing ASTM Designation: C 1293 shall participate in the Cement and Concrete Reference Laboratory (CCRL) Concrete Proficiency Sample Program and shall have received a score of 3 or better on each test of the previous 2 sets of concrete samples.
2. Laboratories performing ASTM Designation: C 1260 shall participate in the Cement and Concrete Reference Laboratory (CCRL) Pozzolan Proficiency Sample Program and shall have received a score of 3 or better on the shrinkage and soundness tests of the previous 2 sets of pozzolan samples.

Aggregates on the list shall conform to one of the following requirements:

1. When the aggregate is tested in conformance with the requirements in California Test 554 and ASTM Designation: C 1293, the average expansion at one year shall be less than or equal to 0.040 percent; or
2. When the aggregate is tested in conformance with the requirements in California Test 554 and ASTM Designation: C 1260, the average of the expansion at 16 days shall be less than or equal to 0.15 percent.

If the aggregates used in the concrete are on the Department of Transportation’s list, the minimum amount of supplementary cementitious material shall conform to the following:

1. If fly ash or natural pozzolan conforming to the provisions in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications is used, the minimum amount of supplementary cementitious material shall be 15 percent by weight of the total cementitious material; or
2. If silica fume conforming to the provisions in Section 90-2.01C, "Required Use of Supplementary Cementitious Materials," of the Standard Specifications is used, the minimum amount of supplementary cementitious material shall be 7 percent by weight of the total cementitious material.

The limitation on tricalcium silicate (C₃S) content in Type II cement specified in Section 90-
2.01A, "Cement," of the Standard Specifications shall not apply.

Order of Work

Order of work shall conform to the provisions in Section 5-1.05, "Order of Work," of the Standard Specifications and these technical specifications.

Soil Nail Wall Earthwork Working Drawings

Attention is directed to the section “Soil Nail Wall Earthwork” of these technical specifications. Prior to performing any soil nail wall earthwork, the Contractor shall submit a complete working drawing submittal for earthwork for each soil nail wall to the Engineer, for review.

Soil Nail Assembly Working Drawings

Attention is directed to the section “Soil Nail Assembly” of these technical specifications. Prior to performing soil nail assembly installation, the Contractor shall submit a complete working drawing submittal for soil nail assemblies to the Engineer, for review.

Shotcrete Test Panels

Attention is directed to the section “Shotcrete” of these technical specifications. Prior to performing shotcrete work, the Contractor shall construct at least 2 preconstruction shotcrete test panels for each mixture being considered. At least 10 working days prior to constructing any shotcrete test panels, the Contractor shall submit a Quality Control Plan (QCP) for the proposed method of shotcrete placement, for review and approval by the Engineer. No construction of shotcrete test panels shall be performed until the QCP is approved by the Engineer. No shotcrete work shall be performed prior to verification by the Engineer of the required compressive strength of the shotcrete in the test panels.

Progress Schedules

Progress schedules are required for this project and shall conform to the provisions in Section 8-1.04, "Progress Schedule," of the Standard Specifications.

A minimum of 48 hours notice shall be given to the Engineer by the Contractor prior to any work requiring inspection. Failure to provide at least 48 hours notice may result in the Engineer rejecting the work. Said notice shall include the date and time of the scheduled work.

Obstructions

Attention is directed to Section 8-1.10, "Utility and Non-Highway Facilities," and Section 15, "Existing Highway Facilities," of the Standard Specifications and these technical specifications.
The Contractor shall notify the Engineer and the appropriate regional notification center for operators of subsurface installations at least 2 working days, but not more than 14 calendar days, prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire or other structure. Regional notification centers include, but are not limited to, the following:

<table>
<thead>
<tr>
<th>Notification Center</th>
<th>Telephone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground Service Alert-Northern California (USA)</td>
<td>(800) 642-2444 (800) 227-2600</td>
</tr>
<tr>
<td>Underground Service Alert-Southern California (USA)</td>
<td>(800) 422-4133 (800) 227-2600</td>
</tr>
</tbody>
</table>

**Mobilization**


**Earthwork**

Earthwork shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications, the Soils Reports by Miller Pacific Engineering Group noted in Section 1.2, “REFERENCE STANDARDS AND QUALITY ASSURANCE”, and these technical specifications.

Drilling, sampling and soil testing was performed by Miller Pacific Engineering Group. The Engineer assumes no responsibility for the accuracy of sufficiency of this data, nor is there any guarantee, either expressed or implied, that unforeseen conditions may not be encountered in the work.

Copies of the Soils Report are available for review at the office of the Soils Engineer.

In case of conflict between the Soils Report and the Standard Specifications and/or these Technical specifications, the Soils Report shall take precedence over and be used in lieu of such conflicting provisions.

Full compensation for conforming to all of the earthwork requirements in the Soils Report, the project plans and these technical specifications shall be considered as included in the contract prices for the items involved and no additional compensation will be allowed therefore.

Surplus excavated material shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.
Reinforcement or metal attached to reinforced concrete rubble placed in embankments shall not protrude above the grading plane. Prior to placement within 2 feet below the grading plane of embankments, reinforcement or metal shall be trimmed to no greater than 3/4 inch from the face of reinforced concrete rubble. Full compensation for trimming reinforcement or metal shall be considered as included in the contract prices paid per cubic yard for the types of excavation shown in the Engineer's estimate, or the contract prices paid for furnishing and placing imported borrow or embankment material, as the case may be, and no additional compensation will be allowed therefor.

Imported borrow shall be mineral material including rock, sand, gravel, or earth. The Contractor shall not use man-made refuse in imported borrow including:

A. Portland cement concrete.
B. Asphalt concrete.
C. Material planed from roadway surfaces.
D. Residue from grooving or grinding operations.
E. Metal.
F. Rubber.
G. Mixed debris.
H. Rubble.

Geocomposite Drains

Geocomposite drains shall conform to the details shown on the plans and the following:

A. Attention is directed to "Engineering Fabrics" under "Materials" of these technical specifications.
B. Geocomposite drain shall consist of a manufactured core not less than 0.25 inch thick nor more than 2 inches thick with one or both sides covered with a layer of filter fabric that will provide a drainage void. The drain shall produce a flow rate, through the drainage void, of at least 2.0 gallons per minute per foot of width at a hydraulic gradient of 1.0 and a minimum externally applied pressure of 5,000 psf.
C. A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications shall be furnished for the geocomposite drain certifying that the drain produces the required flow rate and complies with these technical specifications. The Certificate of Compliance shall be accompanied by a flow capability graph for the geocomposite drain showing flow rates for externally applied pressures and hydraulic gradients. The flow capability graph shall be stamped with the verification of an independent testing laboratory.
E. The manufactured core shall be either a preformed grid of embossed plastic, a mat of random shapes of plastic fibers, a drainage net consisting of a uniform pattern of
polymeric strands forming 2 sets of continuous flow channels, or a system of plastic pillars and interconnections forming a semirigid mat.

F. The core material and filter fabric shall be capable of maintaining the drainage void for the entire height of geocomposite drain. Filter fabric shall be integrally bonded to the side of the core material with the drainage void. Core material manufactured from impermeable plastic sheeting having nonconnecting corrugations shall be placed with the corrugations approximately perpendicular to the drainage collection system.

G. The geocomposite drain shall be installed with the drainage void and the filter fabric facing the embankment. The fabric facing the embankment side shall overlap a minimum of 3 inches at all joints and wrap around the exterior edges a minimum of 3 inches beyond the exterior edge. If additional fabric is needed to provide overlap at joints and wrap-around at edges, the added fabric shall overlap the fabric on the geocomposite drain at least 6 inches and be attached thereto.

H. Should the fabric on the geocomposite drain be torn or punctured, the damaged section shall be replaced completely or repaired by placing a piece of fabric that is large enough to cover the damaged area and provide a minimum 6-inch overlap.

I. Plastic pipe shall conform to the provisions for edge drain pipe and edge drain outlets in Section 68-3, "Edge Drains," of the Standard Specifications.

J. Treated permeable base to be placed around the slotted plastic pipe at the bottom of the geocomposite drain shall be cement treated permeable base conforming to the provisions for cement treated permeable base in Section 29, "Treated Permeable Bases," of the Standard Specifications and these technical specifications.

K. The treated permeable base shall be enclosed with a high density polyethylene sheet or PVC geomembrane, not less than 10 mils thick, which is bonded with a suitable adhesive to the concrete and geocomposite drain. Surfaces to receive the polyethylene sheet shall be cleaned before applying the adhesive. The treated permeable base shall be compacted with a vibrating shoe type compactor.

**Soil Nail Wall Earthwork**

Soil nail wall earthwork, consisting of excavating for soil nail wall construction and backfilling around completed soil nail walls, shall conform to the provisions in Section 19-3, "Structure Excavation and Backfill," of the Standard Specifications, the Soils Reports by Miller Pacific Engineering Group noted in Section 1.2, “REFERENCE STANDARDS AND QUALITY ASSURANCE”, and these technical specifications.

**Excavation**

Care shall be taken during excavation for soil nail walls to prevent disturbing the natural foundation materials behind the face of excavation. During initial mass grading, the Contractor shall not excavate the full wall height to the wall alignment as shown on the plans, but the Contractor shall maintain a working berm of native material in front of the wall to serve as a work bench for the drill equipment. The working berm shall extend out from the wall a
minimum distance of 20 feet and shall be cut down from that point at the slope shown on the approved wall earthwork working drawings. The original ground beyond the wall alignment for the back or ends of the wall as shown on the plans shall not be over excavated. Any such over excavation shall be restored by the Contractor, at the Contractor's expense, using methods and materials approved in writing by the Engineer. Soil stabilization methods or temporary backing or lagging placed behind the excavation face may be required to prevent disturbing the natural foundation materials.

Excavation for walls shall be limited to that area which can be nailed and covered with shotcrete during the same work shift in which the excavation is done. Subsequent excavation shall not be made within 10 feet of previously nailed and covered portions of the wall until those nailed and covered portions are structurally complete. A portion of the wall will be considered structurally complete when the soil nail assemblies have been installed, the shotcrete cover has set, specified testing has been completed for that portion of the wall, and the test results have been furnished to the Engineer.

Excavation for walls shall be performed in such a manner as to avoid damaging the vertical wall reinforcing steel protruding beneath the construction joint of the previously constructed initial shotcrete layer. In case of damage, the reinforcing steel shall be replaced or repaired by the contractor at the contractor's expense.

Excavation to the final wall alignment for the full wall height shall incorporate a working berm which shall be constructed from the top down in a staged lift sequence as shown on the approved wall earthwork working drawings. The ground level in front of the wall face shall not be excavated more than 3 feet below the level of the row of soil nails to be installed in that same lift.

At the option of the Contractor, or if required during construction by the Geotechnical Engineer, in addition to the working berm described above, the Contractor may maintain a stabilizing berm of undisturbed material to support the excavation face during soil nail installation. The stabilizing berm shall extend horizontally from the bottom of the shotcrete a minimum distance of one foot and shall be cut down from that point at a slope as shown on the approved wall earthwork working drawings.

After soil nails are complete in place for a given lift, the stabilizing berm shall be removed during excavation to the final wall alignment. The complete excavated face shall be cleaned of all loose materials, mud, rebound, and other materials that could prevent or reduce shotcrete bond to the excavated face and soil nails.

Temporary backing or lagging for excavation at soil nail walls may be left in place if approved in writing by the Engineer. There shall be no voids behind temporary backing or lagging that is left in place. Fillers used to eliminate voids between the excavation face and temporary backing or lagging shall be dimensionally stable, non-deteriorating material capable of supporting the
earth pressures in both water saturated and dry conditions.

Timber backing or lagging at walls which is to remain in place and is greater than one inch in total thickness shall be pressure treated with wood preservative for soil and fresh water use in conformance with the provisions in Section 58, "Preservative Treatment of Lumber, Timber and Piling," of the Standard Specifications. Wood preservative shall be one of the following: creosote, creosote-coal tar solution, pentachlorophenol, copper naphthenate, ammonia copper arsenate, ammoniacal copper zinc arsenate, acid copper chromate, or chromated copper arsenate.

The Contractor shall remove all cobbles, boulders or portions of boulders, rubble, or debris which are encountered at the final wall alignment during wall face excavation and which protrude from the excavated face more than 2 inches into the design shotcrete thickness as shown on the plans. Such over excavation shall be backfilled with shotcrete.

The Contractor shall immediately notify the Engineer of the occurrence of raveling or local instability of the final wall face excavation due to the presence of groundwater, soil conditions, equipment vibration, or other causes.

Unstable areas shall be temporarily stabilized by means of buttressing the exposed excavation face with an earth berm or other methods approved in writing by the Engineer. Construction of the wall in unstable areas shall be suspended until remedial measures, submitted by the Contractor, and approved by the Engineer, have been taken.

The Contractor shall protect installed soil nails during excavation and subsequent operations. Any soil nails damaged during construction shall be replaced by the Contractor, at the Contractor's expense.

Construction Tolerances: The soil nail walls shall be excavated and placed to satisfy the following tolerances:

1. The horizontal alignment of the front face of the soil nail wall shall be within 0.10-feet of the Retaining Wall Layout Line (RWLOL).
2. The front face of the soil nail wall shall not be out of the required batter alignment perpendicular to the Retaining Wall Layout Line (RWLOL) more than the lesser of the following: 0.7 percent over the wall design height, nor 0.10-feet.

Soil nail wall alignment with respect to the RWLOL and the specified batter tolerances shall be measured and recorded by the inspector after the shotcrete face has set up. Wall segments that do not meet the tolerances outlined above will be rejected.

**Soil Nail Assembly**

Soil nail assemblies and test soil nail assemblies, consisting of drilling holes in natural
foundation materials, installing and grouting steel bars in drilled holes, anchorage systems, and testing of test soil nail assemblies, shall conform to the details shown on the plans, the provisions of the Standard Specifications, and these technical specifications.

Attention is directed to "Order of Work" and "Soil Nail Wall Earthwork" of these technical specifications.

**Materials**

The materials specified below shall be used for construction of soil nail assemblies and test soil nail assemblies.

**Soil Nail:**

Soil nails shall conform to the provisions for bar reinforcement in Section 52, "Reinforcement," of the Standard Specifications. When Grade 60 soil nails are shown on the plans, the soil nails shall also conform to the requirements in ASTM Designation: A 615/A 615M or A706/A706M. When Grade 75 soil nails are shown on the plans, the soil nails shall also conform to the requirements in ASTM Designation: A 615/A 615M. The soil nail shall be either a reinforcing bar encapsulated full length in a grouted corrugated plastic sheathing or an epoxy coated reinforcing bar partially encapsulated in a grouted corrugated plastic sheathing. The bar shall be centered in the sheathing and the space between the sheathing and the bar shall be filled with grout. The epoxy coating shall have a minimum thickness of 12 mils.

Soil nail assemblies shall be lengthened or additional soil nail assemblies shall be installed when ordered by the Engineer.

Soil nails shall have a minimum length of 6 inches of thread on the anchorage end. Threading may be continuous spiral deformed ribbing provided by the bar deformations or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the bar size shall be the next larger bar designation number from that shown on the plans, and coarse threads shall be used. The epoxy coating at the anchorage end of epoxy coated bars may be omitted for a maximum length of 6 inches. Metal surfaces of assembled splices of epoxy coated bars shall be epoxy coated.

Corrugated plastic sheathing shall be either polyvinyl chloride (PVC) or high density polyethylene (HDPE). The minimum sheathing wall thickness shall be 40 mils.

HDPE shall have a density between 0.940 and 0.960-g/cm³ when measured in conformance with the requirements in ASTM Designation: D 792, A-2.

The sheathing shall have sufficient strength to prevent damage during construction operations and shall be watertight, chemically stable without embrittlement or softening, and nonreactive with concrete.
Splicing of soil nails shall be made only at the locations shown on the plans or at ends of soil nails which the Engineer has ordered to be lengthened.

**Test Soil Nail:**

Test soil nails shall conform to the provisions for bar reinforcement in Section 52, "Reinforcement," of the Standard Specifications.

Test soil nail assemblies shall be lengthened or additional test soil nail assemblies shall be installed when ordered by the Engineer.

Test soil nails need not be epoxy coated or encapsulated in grouted plastic sheathing.

Splicing of test soil nails shall be made only at locations outside of the bonded length.

**Anchorage System:**

Anchorage for soil nails shall conform to the details shown on the plans and the provisions in Section 75-1.02, "Miscellaneous Iron and Steel," of the Standard Specifications, except that nuts, washers, wedges, and bearing plates to be fully encased in concrete, grout, or shotcrete need not be galvanized. Concrete anchors on the bearing plates shall conform to the provisions for stud connectors in Section 55-2, "Materials," of the Standard Specifications.

The ultimate strength of the soil nail anchorage shall be at least the value shown below for the size of the soil nail bar shown on the plans.

<table>
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<tr>
<th>BAR SIZE</th>
<th>ANCHORAGE ULTIMATE STRENGTH (kips)</th>
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<tbody>
<tr>
<td></td>
<td>Grade 60</td>
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<td>No. 9</td>
<td>90</td>
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<tr>
<td>No. 10</td>
<td>114</td>
</tr>
</tbody>
</table>

**Grout:**

Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications. California Test 541 will not be required nor will the grout be required to pass through a screen with a 0.07-inch maximum clear opening prior to being introduced into the grout pump. Fine aggregate may be added to the grout mixture of cement and water in
drilled holes 6 inches or greater in diameter, but only to the extent that the cement content of the grout is not less than 930 pounds per cubic yard of grout. Fine aggregate, if used, shall conform to the provisions in Section 90-2, "Materials," and Section 90-3, "Aggregate Gradings," of the Standard Specifications. Grout with fine aggregate shall have a nominal penetration equal to or greater than 90 mm (3.5-inches) when measured in conformance with California Test 533 and shall have an air content of equal to or less than 2 percent when measured in conformance with California Test 504. Air entraining admixtures shall not be used for grout with fine aggregate.

The consistency of grout with fine aggregate shall be verified prior to use by producing a batch to be tested. The test batch shall be produced and delivered to the project under conditions and in time periods similar to those expected during the placement of grout in the soil nails. Grout for the test batch shall be placed in an excavated hole or suitable container of adequate size to allow testing in conformance with California Test 533. The test batch shall demonstrate that the proposed grout mix achieves the specified nominal penetration. Upon completion of the testing, the grout shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

Construction

Soil nails shall be installed in drilled holes in an expeditious manner so that caving or deterioration of the drilled hole does not occur. No portion of the drilled hole shall be left open for more than 60 minutes prior to soil nail placement and grouting unless otherwise approved by the Engineer.

Difficult soil nail assembly construction is anticipated due to the presence of fractured sandstone and greenstone materials, existing trees, intermittent ground water, underground utilities and overhead utilities.

Intermittent ground water is likely to be encountered during construction of soil nails. The geotechnical engineer will provide recommendations for appropriate measures to capture water and alleviate hydrostatic pressure. The installation of Caltrans standard vertical drains (hydro-augers) may be required at some locations.

Drilling:

Drilling equipment shall be designed to drill straight and clean holes. The drilling method and the size and capability of the drilling equipment shall be as approved in the working drawings. Drill rigs shall have the capability of anchorage installation and grout placement through the use of drill casing or hollow-stem augers.

At locations where caving conditions are anticipated, sufficient casing and auger lengths shall be available on site to maintain uninterrupted installation of anchors.
At locations where hard drilling conditions such as rock, cobbles, boulders, or obstructions are anticipated, a down hole pneumatic hammer drill rig and drill bit shall be available on site to drill holes for soil nail assemblies.

Drilled holes for walls shall not extend beyond the right-of-way or easement limits as shown on the plans or as specified in these technical specifications.

Holes shall be drilled in the natural foundation materials. Holes for test soil nail assemblies shall be of the same diameter as those for the production soil nail assemblies they represent.

Holes shall be cleaned to remove material resulting from the drilling operations and to remove any other material that would impair the strength of the soil nail assemblies or test soil nail assemblies. Foreign material dislodged or drawn into the holes during construction of the assemblies shall be removed. Water for cleaning holes shall not be used, unless full hole length hollow-stem augers or casing is maintained in the same hole during cleaning and soil nail assembly installation. Soil nail assemblies and test soil nail assemblies shall not be installed in the drilled holes until the holes have been inspected by the Engineer.

**Installing Soil Nails and Test Soil Nails:**

Soil nails and test soil nails shall be installed in the drilled holes using centralizers. Centralizers shall adequately support the bar in the center of the drilled hole and shall be spaced at a maximum of 5 feet on center along the length of the bar, and 20 inches from the end of the bar.

Where the soil nail cannot be completely inserted, the Contractor shall remove the bar and clean or redrill the hole to permit unobstructed installation. Partially installed bars shall not be driven or forced into the drilled hole and will be rejected. When open-hole drilling methods are being used, the Contractor shall have hole cleaning tools on-site suitable for cleaning drilled holes along their full length just prior to bar insertion and grouting.

**Grouting:**

The length of drilled hole shall be verified and recorded by the Contractor before grouting.

Grout shall be injected at the low end of the drilled hole and shall fill the drilled hole with a dense grout free of voids or inclusion of foreign material. Cold joints shall not be used in grout placement. Soil nails shall be grouted full length.

Only the bonded length of test soil nails shall be initially grouted. Initial grouting shall be confined to the bonded length by packers or other approved devices. For test soil nails, grouting of the remainder of the drilled hole shall not be done until pullout tests have been completed and approved by the Engineer.
After placing the grout for soil nails and test soil nails, they shall remain undisturbed for the cure time stated in the approved soil nail working drawings.

**Securing Soil Nails:**

Any remaining void at the exterior end of the drilled hole for a soil nail assembly shall be filled with shotcrete and the soil nail secured at the face of the shotcrete. The steel bearing plate shall be seated with full bearing on the shotcrete surface and the nut for the soil nail shall be hand tightened before the initial set of the shotcrete. The nut shall be made wrench tight after the shotcrete has set for 24 hours, unless a shorter time is approved by the Engineer.

**Securing Test Soil Nails:**

Testing shall be performed against a temporary bearing yoke which bears directly on the shotcrete facing. Test loads transmitted through the temporary bearing yoke shall not fracture the shotcrete or cause displacement or sloughing of the soil surrounding the drilled hole. No part of the yoke shall bear within 6 inches of the edge of blockout.

Test soil nails shall be removed to behind the front face of the shotcrete after testing has been completed. The remaining length of void in the drilled hole shall be grouted and the blockout in the shotcrete facing filled with either grout or shotcrete.

**Testing**

Test soil nail assemblies shall be pullout tested by the Contractor in the presence of the Engineer. A pullout test shall consist of incrementally loading the assembly until either the pullout test load has been held for one minute or the total measured movement of the soil nail exceeds 2-inches, at which point the load shall be recorded as part of the test data and submitted to the Engineer at the conclusion of each test.

The Contractor shall monitor and record total movement of the test soil nail relative to the grout during application of the test load.

Applied test loads shall be determined by using either a calibrated pressure gage or a load cell. Movements of the end of the soil nail, relative to an independent fixed reference point, shall be measured and recorded to the nearest 0.001-inch at each increment of load, including the ending alignment load, during the load tests.

The pressure gage shall have an accurately reading dial at least 6 inches in diameter. Each jack and its gage shall be calibrated as a unit with the cylinder extension in the approximate position that it will have at final jacking force, and shall be accompanied by a certified calibration chart. Each jack and pressure gage assembly shall be calibrated in conformance with Section 50-1.08, "Prestressing," of the Standard Specifications. The Contractor shall furnish to the Engineer for
approval, documentation and calibration results indicating the date and results of the Caltrans Transportation Laboratory Calibration for the jack and pressure gages to be used for testing. The Contractor shall furnish to the Engineer the certified calibration results a minimum of 5 working days prior to testing. The load cell shall be calibrated and shall be provided with an indicator capable of measuring the test load in the soil nail. The range of the load cell shall be such that the lower 10 percent of the manufacturer's rated capacity will not be used in determining the jacking force.

The Contractor shall provide sufficient labor, equipment, and material to install and support load cells or pressure gages, or Vibra-Tension equipment operated in conformance with California Test 677, for testing of soil nails and to remove the testing equipment after the testing is complete, as ordered by the Engineer.

The pullout test procedures shall conform to the following:

A. The pullout test shall be conducted by measuring and recording the test load applied to the test soil nail and the test soil nail end movement at each load listed in the following loading schedule.

PULLOUT TEST LOADING SCHEDULE

<table>
<thead>
<tr>
<th>AL</th>
<th>M = 0.20M</th>
<th>0.30M</th>
<th>0.40M</th>
<th>0.50M</th>
<th>0.60M</th>
<th>0.70M</th>
<th>0.80M</th>
<th>0.90M</th>
<th>1.00M (PULLOUT TEST LOAD)</th>
</tr>
</thead>
</table>

(M = MAXIMUM TEST LOAD (kips) = 0.5464 \( \tau_b \) D)

Where \( \tau_b \) = Ultimate bond stress between grout and drilled hole as shown on the plans, in psi; and D = actual drilled hole diameter, in inches.

(AL = ALIGNMENT LOAD = 0.1M)

B. Each increment of load shall be applied in less than one minute and held for at least one minute but not more than 2 minutes, except that the load equal to 0.70M shall be held for 10 minutes. During the 10-minute load hold, the movement of the end of the soil nail shall be measured at 1, 2, 3, 4, 5, 6, and 10 minutes. The observation period for the 10-minute load hold shall start when the pump begins to apply the increment of load.
from 0.60M to 0.70M. If the creep movement measured between one minute and 10 minutes at 0.70M is less than 0.04-inch, the load shall continue to be increased incrementally to 1.00M, then reduced to the ending alignment load. The test soil nail assembly shall be considered acceptable if 1) the creep movement measured between one minute and 10 minutes is less than 0.04-inch, 2) the total measured movement is greater than 80 percent of the theoretical elastic elongation of the test nail unbonded length at the 1.0M load, and 3) the total measured movement is less than 2-inches.

C. If the load of 0.70M cannot be maintained for 10 minutes with 0.04-inch or less creep movement, the 0.70M load shall be maintained for an additional 50 minutes. Total movement shall be measured at 15, 20, 25, 30, 45, and 60 minutes. If the test load is held for 60 minutes, a creep curve showing the creep movement between 10 minutes and 60 minutes shall be plotted as a function of the logarithm of time. If the creep curve plotted from the movement data indicates a creep rate of less than 0.08-inch for the last log cycle of time, the load shall continue to be increased incrementally to 1.00M, then reduced to the ending alignment load. The test soil nail assembly shall be considered acceptable if 1) the creep curve plotted from the movement data indicates a creep rate of less than 0.08-inch for the last log cycle of time, 2) the total measured movement is greater than 80 percent of the theoretical elastic elongation of the test nail unbonded length at the 1.0M load, and 3) the total measured movement is less than 2-inches.

D. The soil nail shall be unloaded only after completion of the test.

Test soil nails that fail to meet acceptance criteria shall be extracted when requested by the Engineer.

Concrete Structures

Portland cement concrete structures shall conform to the provisions in Section 51, "Concrete Structures," of the Standard Specifications and these technical specifications.

Reinforcement

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these technical specifications.

The Department of Transportation's mechanical splices prequalified list can be found at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

Shotcrete

Shotcrete shall conform to the provisions in Section 51, "Concrete Structures," and Section 53,
"Shotcrete," of the Standard Specifications and these technical specifications.

Shotcrete operations shall completely encase all reinforcement and other obstructions shown on the plans. Exceptional care shall be taken to properly encase the reinforcement and other obstructions with shotcrete.

Attention is directed to the section, "Order of Work," in these technical specifications regarding furnishing preconstruction shotcrete test panels.

Except for finish coats, shotcrete shall be applied by the wet-mix process only.

Finish coats, applied by the dry-mix process, may be used only when approved by the Engineer.

Shotcrete shall have a minimum compressive strength of 3250 psi at 28 days or as shown on the plans, whichever is greater. No shotcrete work shall be performed prior to verification by the Engineer of the required compressive strength.

Splicing of reinforcing bars No. 7 or larger in shotcrete shall be by butt splicing only.

The Contractor shall be responsible for obtaining and testing all required preconstruction and production test cores. All coring and testing shall be at the Contractor's expense and performed in the presence of the Engineer, unless otherwise directed. The Engineer shall be notified a minimum of 24 hours prior to the Contractor performing any coring or testing operations.

All cores shall be obtained and tested for compressive strength in conformance with the requirements in ASTM Designation: C 42/C 42M. Cores used for determining compressive strength shall not contain any bar reinforcement or other obstructions. The testing shall be performed at an independent testing facility approved by the Engineer. A copy of the test results shall be furnished to the Engineer within 5 days following completion of testing.

All test panels shall become the property of the Contractor and shall be disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

_Preconstruction Requirements_

Prior to performing shotcrete work, the Contractor shall construct at least 2 preconstruction shotcrete test panels for each mixture being considered unless otherwise specified.

The nozzleperson shall have a minimum of 3000 hours experience as a nozzleperson on projects with a similar application.

Preconstruction shotcrete test panels shall be constructed by the nozzlepersons and application
crew scheduled to do the work, using equipment, materials, mixing proportions, ambient temperatures and procedures proposed for the work. The preconstruction shotcrete test panels shall conform to the following:

A. One shotcrete test panel, of the size determined by the Contractor, shall be unreinforced and shall have 3 cores taken from it and tested for compressive strength. The compressive strength shall be the average strength of the 3 cores, except that, if any core should show evidence of improper coring, the core shall be discarded and the compressive strength shall be the average strength of the remaining cores. The test panel shall be identified and submitted to the Engineer with the test results including a description of the mixture, proportions, and ambient temperature.

B. One shotcrete test panel shall have the same (1) thickness, (2) bar size and amount of bar reinforcement or other obstructions, and (3) positioning of bar reinforcement or obstructions as the most heavily reinforced section of shotcrete to be placed. The test panel shall be square with the length of the sides equal to at least 3 times the thickness of the most heavily reinforced section of shotcrete to be placed, but not less than 30 inches. After a minimum 7 days of cure, the test panel shall be broken by the Contractor, in the presence of the Engineer, into pieces no larger than 10 inches in greatest dimension. The surfaces of the broken pieces shall be dense and free of laminations and sand pockets, and shall verify that the bar reinforcement or other obstructions are completely encased.

C. Both test panels shall be cured under conditions similar to the actual work.

D. At the option of the Contractor, cores to be used for determining the compressive strength may be taken from the reinforced test panel described above in lieu of making a separate unreinforced test panel as described above. The compressive strength shall be the average strength of the 3 cores, except that, if any core should show evidence of improper coring or contains bar reinforcement or other obstructions, the core shall be discarded and the compressive strength shall be the average strength of the remaining cores. If cores are taken from the reinforced test panel, the panel shall not be broken into pieces, as described above, until it has cured for a minimum of 14 days.

**Placing**

An air blowpipe shall be used during shotcrete placement to remove rebound, overspray, and other debris from the areas to receive shotcrete.

Construction joints shall be tapered and shall conform to the provisions in Sections 51-1.13, "Bonding," of the Standard Specifications.

All overspray and rebound shall be removed prior to final set and before placement of shotcrete on adjacent surfaces.

Rebound or any other material which has already exited the nozzle shall not be reused.

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Soil Nail Wall
Site Infrastructure Technical Specifications
Dry Creek Rancheria Band of Pomo Indians

June 2, 2008
Section 02487A-57
Shotcrete shall be cured in conformance with the provisions of Section 90-7.03, "Curing Structures," of the Standard Specifications.

When a finish coat is to be used, all loose, uneven or excess material, glaze, and rebound shall be removed by brooming, scraping, or other means and the surface left scarified. Any surface deposits which take a final set shall be removed by abrasive blasting. Prior to placing the finish coat, the receiving surface shall be washed down with an air-water blast.

**Testing and Acceptance**

At least 3 production shotcrete test cores shall be taken from each 300 square feet or portion thereof of shotcrete placed each day. The cores shall be 3 inches in diameter. The location where cores are to be taken will be designated by the Engineer. Test cores shall be identified by the Contractor, and a description of the core location and mixture, including proportions, shall be provided to the Engineer/Inspector with the test cores, immediately after coring. Cored holes shall be filled with mortar in conformance with the provisions in Section 51-1.135, "Mortar," of the Standard Specifications.

Upon receipt of the cores, the Engineer/Inspector will perform a visual examination to determine acceptance, as described below. The Engineer/Inspector shall also take a photograph and compile a photographic record of all production cores. Within 48 hours after receipt, the Engineer will return the cores to the Contractor for compressive strength testing.

The compressive strength test shall be performed using the shotcrete production test cores described above. The compressive strength shall be the average strength of the 3 cores, except that, if any core should show evidence of improper coring, the core shall be discarded, and the compressive strength shall be the average strength of the remaining cores.

The basis of acceptance for production shotcrete test cores shall be (1) that the core is dense and free of laminations and sand pockets, and shows that the reinforcement or other obstructions are completely encased and (2) the same as specified for test cylinders in the fourth and fifth paragraphs of Section 90-9.01, "General," of the Standard Specifications.

If any production test core shows signs of defective shotcrete as described in (1) above, the shotcrete represented by such test core will be rejected, unless the Contractor, at the Contractor’s expense, obtains and submits evidence acceptable to the Engineer that the strength and quality of the shotcrete placed in the work are acceptable.

The surface finish of the shotcrete shall conform to the provisions of Section 51-1.18, "Surface Finishes," of the Standard Specifications, and the project plans.

**Timber Lagging**

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Soil Nail Wall  
Site Infrastructure Technical Specifications  
Dry Creek Rancheria Band of Pomo Indians  
June 2, 2008  
Section 02487A-58
Temporary timber backing or lagging that is to remain in place shall conform to the provisions in Sections 57, "Timber Structures," and 58, "Preservative Treatment of Lumber, Timber and Piling," of the Standard Specifications and these technical specifications.

Preservative treatment shall conform to AWPA Use Category System: UC4B, Commodity Specification A, except that chromated copper arsenate shall not be used.

END OF SECTION
SECTION 02510
WATER SYSTEM

PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Site water distribution system for domestic and fire protection service up to 5 feet of any on-site commercial building being served.

B.  Domestic water and fire protection water transmission or distribution system within a roadway or street right-of-way.

1.2  RELATED SECTIONS

A.  Section 02310, Utility Trenching and Backfill.

B.  Section 03301 Minor Concrete.

1.3  RELATED DOCUMENTS

A.  ASTM:
2.  B 88:  Specifications for Seamless Copper Water Tube.
3.  D 1785:  Specifications for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

B.  AWWA:
3.  C110:  Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm) for Water.
9.  C200:  Steel Water Pipe-6 In. (150 mm) and larger.
12. C207: Steel Pipe Flanges for Waterworks Service-Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
19. C219: Bolted, Sleeve-type Couplings for Plain-End Pipe.
24. C507: Ball Valves 6 In. Through 8 In. (150 mm Through 1,200 mm).
25. C508: Swing-check Valves for Waterworks Service, 2 In. (50mm) Through 24 In. (600 mm) NPS.
27. C510: Double Check Valve Backflow-Prevention Assembly.
28. C511: Reduced-Pressure Principle Backflow-Prevention Assembly.
33. C606: Grooved and Shouldered Joints.
34. C651: Disinfecting Water Mains.
36. C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fittings, 4 In. Through 12 In. (100mm Through 300mm) for Water Distribution.
37. C901: Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13mm) Through 3 In. (76mm) for Water Service.
38. C905: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm) for Water Transmission and Distribution.
39. C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In (1,575 mm), for Water Distribution and Transmission.
40. C907: Polyvinyl Chloride (PVC) Pressure Fittings for Water – 4 In. through 8 In. (100 mm Through 200 mm).
44. M41: Ductile-Iron Pipe and Fittings.


1.4 DEFINITIONS

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


C. AWWA: American Waterworks Association

D. DI: Ductile iron.

E. DIP: Ductile iron pipe.

F. FM: Factory Mutual.


H. NSF: National Sanitation Foundation.


J. PE: Polyethylene.

K. PVC: Polyvinyl Chloride.

L. UL: Underwriters Laboratory.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Minimum Internal Pressure: 200-psi.

B. External Load: Earth load indicated by depth of cover plus AASHTO H20 live load unless indicated otherwise.
C. Fire Service Lines: All fire service lines shall be a minimum of Class 200 for PVC.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01330.

B. Product Data: For the following:
   1. Piping materials and fittings.
   2. Pipe couplings.
   3. Flexible pipe fittings.
   4. Restrained pipe fittings.
   5. High deflection fittings/ball joints.
   7. Flexible expansion joints.
   8. Gate valves.
  10. Check valves.
   11. Air and vacuum relief valves.
   13. Pressure reducing valves.
   14. Pressure sustaining valves.
   15. Ball valves.
   16. Fire hydrants.
   17. Post indicator valves.
   18. Fire department connections.
   20. Precast valve boxes and box covers.

C. Shop drawings: Include plans, elevations, details and attachments.
   1. Precast and cast in-place vaults and covers.
   2. Wiring diagrams for alarm devices.

D. Field test reports: Indicate and interpret test results for compliance with the Project requirements.

1.7 QUALITY ASSURANCE

A. Comply with requirements of utility supplying water. Do not operate existing valves or tap existing piping without written permission and/or presence of utility system representative.
B. Comply with the following requirements and standards:

C. Provide listing/approval stamp, label, or other marking on piping and specialties made to a specified standard.

1.8 MATERIAL DELIVERY, STORAGE AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.

B. Deliver piping with factory-applied end-caps. Maintain end-caps through shipping, storage and handling to prevent pipe end damage and to prevent entrance of dirt, debris and moisture.

C. Handling: Use slings to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. During Storage: Use precautions for valves, including fire hydrants according to the following.
   1. Do not remove end protectors, unless necessary for inspection, then reinstall for storage.
   2. Protection from Weather: Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

E. Do not store plastic pipe and fittings in direct sunlight.

F. Protect pipe, fittings, flanges, seals and specialties from moisture, dirt and damage.

G. Protect linings and coatings from damage.

H. Handle precast boxes, vaults and other precast structures according to manufacturer’s written instructions.
I. Protect imported bedding and backfill material from contamination by other materials.

1.9 COORDINATION

A. Coordinate connection to existing water mains with water utility supplying water.

B. Coordinate piping materials, sizes, entry locations, and pressure requirements with building domestic water distribution piping and fire protection piping.

PART 2 PRODUCTS

2.1 SMALL SIZE SERVICE PIPES

A. Copper Pipe: Sizes ¾-inch through 2-inch. [PREFERRED]
   2. Joints: Restrain by couplings.

B. PE Plastic Pipe: Sizes ½-inch through 3-inch. [ONLY TO BE USED WHERE SHOWN ON PLANS]
   1. Pipe and Fittings: AWWA C901.
   2. Joints: Restrain with clamps or heat-fusion.

C. PVC Pipe: Sizes 1/8-inch through 3 inch. [ONLY TO BE USED WHERE SHOWN ON PLANS]

2.2 LARGE SIZE SERVICE AND DISTRIBUTION PIPES

A. DIP: Sizes 4-inch through 48-inch. [ONLY TO BE USED WHERE SHOWN ON PLANS]
   2. Fittings
      a. Standard: AWWA C110, sizes 4-inch through 48-inch.
      b. Compact: AWWA C153, sizes 4-inch through 24-inch.
   3. Pipe and Fitting Lining: Cement Mortar, AWWA C104.
   4. Pipe and Fitting Coating: Asphalctic, AWWA C151 or C115.
   5. Unrestrained Joints:
      a. Push-On Bell and Spigot Joint: AWWA C111.
      b. Mechanical Joint: AWWA C111.
   6. Restrained Joints:
a. Flanged Joint: AWWA C115.
b. Push-On Bell and Spigot Joint: AWWA C111 with “Field Lok Gasket,” sizes 4-inch through 24-inch; “TR Flex,” sizes 4-inch through 64-inch; both by U. S. Pipe (Birmingham AL) (Tel. 205-254-7442) or approved equal. “Megalug” restraint harness, Ebba Iron (Eastland TX) (Tel 800-443-1716) or approved equal.
c. Mechanical Joint: AWWA C111 with “Mega Lug,” sizes 3-inch through 48-inch. Ebba Iron (Eastland TX) (Tel 800-443-1716) or approved equal.

7. Couplings:
   a. Plain End Pipe to Plain End Pipe: Ductile iron or steel bolted couplings, manufacturer’s shop coating with low alloy steel bolts and nuts. Steel couplings to conform to AWWA C219. Smith-Blair, Inc, (Texarkana, AR) (Tel. 501-773-5127), Dresser (Bradford, PA) (Tel.-814-368-3131) or approved equal.
   b. Plain End Pipe to Flanged Pipe: 1) Ductile iron or steel bolted flanged coupling adapters, manufacturer’s shop coating with low alloy steel bolts and nuts. Steel flanged couplings to conform to AWWA C219. Smith-Blair, Inc, (Texarkana, AR) (Tel. 501-773-5127), Dresser (Bradford, PA) (Tel.-814-368-3131) or approved equal; or 2) restrained flange adapter, “Megaflange,” sizes 3-inch through 36 inch, Ebba Iron (Eastland TX) (Tel 800-443-1716) or approved equal.

B. PE Pipe: Sizes 4-inch through 64-inch. [ONLY TO BE USED WHERE SHOWN ON PLANS]
   2. Joints:
      a. Thermal Butt Fusion: AWWA C906 and pipe manufacturer’s recommendations.
      b. Flanged joining: AWWA C906 and pipe manufacturer’s recommendations.
      c. Other: Check with pipe manufacturer.

C. PVC Pipe: Sizes 4-inch through 48-inch. [PREFERRED]
   1. Pipe:
      a. 4-inch through 12-inch: AWWA C900, Class 200, DR 14.
      b. 14-inch through 48-inch: AWWA C905.
   2. Fittings: DI conforming to 2.2A above.
   3. Unrestrained Joints:
   4. Restrained Joints:
      a. Push-On Bell and Spigot Joint: Harness assembly as manufactured by Ebba Iron (Eastland, Tx) (Tel. 800-433-1716) or approved equal.
      b. Plain End PVC to DI Mechanical Joint: Ebba Iron (Eastland, Tx) (Tel. 800-433-1716) or approved equal.
5. Steel or Ductile Iron Couplings:
   a. Plain End Pipe to Plain End Pipe: Ductile iron or steel bolted couplings, manufacturer’s shop coating with low alloy steel bolts and nuts. Steel couplings to conform to AWWA C219. Smith-Blair, Inc, (Texarkana, AR) (Tel. 501-773-5127), Dresser (Bradford, PA) (Tel.-814-368-3131) or approved equal.
   b. Plain End Pipe to DI or Steel Flanged Pipe: Ductile iron or steel bolted flanged coupling adapters, manufacturer’s shop coating with low alloy steel bolts and nuts. Steel flanged couplings to conform to AWWA C219. Smith-Blair, Inc, (Texarkana, AR) (Tel. 501-773-5127), Dresser (Bradford, PA) (Tel.-814-368-3131) or approved equal.

6. PVC Couplings
   a. Unrestrained Plain End to Plain End Pipe: AWWA C900, as manufactured by CertainTeed (Valley Forge, PA) (Tel. 610 341-6820) or approved equal.
   b. Restrained Plain End to Plain End Pipe: AWWA C900, “Certa-Lock” as manufactured by CertainTeed (Valley Forge, PA) (Tel. 610 341-6820) or approved equal.

2.3 HIGH DEFLECTION FITTINGS/BALL JOINTS
   A. Plain End Pipe: Xtra Flex Restrained Joint High Deflection Fittings, 4-inch through 24-inch, U. S. Pipe, (Birmingham, AL) (Tel. 205-254-7442) or approved equal.
   B. Mechanical or Flanged Joint: Flex 900, 4-inch through 12-inch, Ebaa Iron Sales, (Eastland, TX) (Tel. 800-433-1716) or approved equal.

2.4 EXPANSION JOINTS
   A. TR Flex Joints: TR Flex Telescoping Sleeve, 4-inch through 64 inch, U. S. Pipe, (Birmingham, AL) (Tel. 205-254-7442).
   B. Mechanical or Flanged Joint: Ex-Tend 200, 4-inch through 36-inch, EBAA Iron Sales, (Eastland, TX) (Tel. 800-433-1716) or approved equal.

2.5 FLEXIBLE EXPANSION JOINTS
   A. Plain End to Plain End Pipe: “Xtra Flex,” sizes 4-inch through 24-inch, U. S. Pipe, (Birmingham AL) (Tel. 205-254-7442) or approved equal.
   B. Flanged or mechanical Joint: “Flex-Tend,” sizes 3-inch through 48-inch, Ebaa Iron (Eastland TX) (Tel. 800-433-1716) or approved equal.
   C. Flanged Joint: Starflex, Series 500, Star Pipe Products, (Tel. 800-999-3009) or approved
2.6 SERVICE LINE VALVES AND FITTINGS

A. General: AWWA C-800

B. Includes service lines, ½ inch through 2 inch, from main to meter valve, including corporation stops and curb stops.

2.7 GATE VALVES

A. Provide on lines 10-inch and smaller.

B. Valves, 3-Inch through 10-Inch: AWWA C509, resilient-seated, non-rising stem, gray or ductile-iron body and bonnet, with bronze or gray or ductile-iron gate, bronze stem and square stem operating nut unless noted otherwise. All bolts, nuts and washers, except operating nut, shall be stainless steel. Stem operating nut to be 2-inches square and open counter-clockwise. Stem extensions shall be installed to bring the stem operating nut to within 2-feet of finish grade where the depth from finish grade to the stem operating nut exceeds 4-feet. Equip valves in pump stations and other interior or vault installations with hand-wheels. Provide protective epoxy interior and exterior coating according to AWWA C550 and manufacturer’s recommendations.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:

D. Valve Box and Cover: 9-inch minimum diameter PCC box with extensions of length required for depth of bury of valve, and cast iron or ductile iron cover with lettering “WATER”. Both the box and the cover shall be rated for AASHTO H20 loading. For T22 recycled water system, valve box cover shall be painted purple.

2.8 BUTTERFLY VALVES

A. Provide on lines larger than 10-inch.

B. Valves, 12-Inch through 72-Inch: AWWA C 504, rubber seated, Class 150B cast iron body, cast or ductile iron discs, stainless steel shafts, adjustable field replaceable rubber seats mating against stainless steel seat rings and field-replaceable seals. Flanged or
mechanical joint end connections. No wafer type valves allowed. Traveling nut type valve actuators designed for buried service unless noted otherwise. All bolts, nuts and washers, except wrench nut, shall be stainless steel. Wrench nut to be 2-inches square and open counter-clockwise. Stem extensions shall be installed to bring the wrench nut to within 2-feet of finish grade where the depth from finish grade to the wrench nut exceeds 4-feet. Equip valves in pump stations and other interior or vault installations with hand-wheels. Provide protective epoxy interior and exterior coating according to AWWA C550 and manufacturer’s recommendations.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:

D. Valve Box and Cover: 9-inch minimum diameter PCC box with extensions of length required for depth of bury of valve, and cast iron or ductile iron cover with lettering “WATER”. Both the box and the cover shall be rated for AASHTO H20 loading. For T22 recycled water system, valve box cover shall be painted purple.

2.9 AIR RELEASE, AIR/VACUUM AND COMBINATION AIR VALVES

A. AWWA C512, specific type of valve, size, details and valve box as indicated.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
   1. Apco Valves, Valve and Primer Corporation (Schaumburg, IL) (Tel. 708-529-9000).
   2. Crispin.

2.10 BLOW-OFF VALVES

A. Blow-off valve assemblies, details and boxes as indicated on Plans.

2.11 SWING CHECK VALVES

A. Valves 2-Inch through 24-Inch: AWWA C508, details as indicated on Plans.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited
to, the following:

2.12 BALL VALVES

A. Valves 6-Inch through 48-Inch: AWWA C507, details as indicated.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:

2.13 PRESSURE-REGULATING VALVES

A. Valve: Automatic, pilot-operated, cast-iron body with interior coating according to AWWA C550. 250-psi Working-pressure, bronze pressure-reducing pilot valve and tubing, and means for discharge pressure adjustment. Details as indicated.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:

2.14 FLOW-REGULATING VALVES

A. Valve: Automatic, pilot-operated, cast-iron body with interior coating according to AWWA C550. 250-psi working-pressure, bronze pressure-reducing pilot valve and tubing, and means for flow adjustment. Details as indicated.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
2.15 SERVICE CONNECTIONS AND WATER METERS

A. Service connections and water meter details and boxes as indicated on the Plans.

2.16 FIRE HYDRANTS

A. Wet Barrel: AWWA C503, with two 2½-inch and one 4 ½-inch outlets, details as indicated.

B. Approved Manufacturer and Model: Clow 960. Clow Corporation (Oskaloosa, IA) (Tel. 800-829-2569, www.clowvalve.com)

2.17 REDUCED-PRESSURE-PRINCIPLE BACKFLOW PREVENTER

A. Provide as indicated and as required by DCGC.

B. General: AWWA C511, with OS gate valve on inlet and outlet, and strainer on inlet. Include test cocks and pressure-differential relief valve with ASME A112.1.2 air gap fitting located between 2 positive-seating check valves for continuous-pressure application.

C. Body:
   1. 2-Inch and Smaller: Bronze with threaded ends.
   2. 2-1/2-Inch and Larger: Bronze, cast iron steel, or stainless steel with flanged ends.

D. Interior Lining: AWWA C550, epoxy coating for cast iron or steel bodies.

E. Interior Components: Corrosion-resistant materials.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
   4. Hersey Products, Inc. (Dedham, MA) (Tel. 617-326-9400).
2.18 DOUBLE CHECK DETECTOR ASSEMBLY

A. FM approved or UL listed, listed and approved by the Department of Health, with OS&Y gate valve on inlet and outlet, and strainer on inlet. Include two positive-seating check valves and test cocks.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
   4. Hersey Products, Inc. (Dedham, MA) (Tel. 617-326-9400).

2.19 POST INDICATOR VALVE

A. General: UL 789, FM approved, vertical-type, cast-iron body with operating wrench extension rod, adjustable cast-iron barrel of length required for depth of bury of valve, and painted red.

B. Provide fire panel contact for remote monitoring.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:

2.20 FIRE DEPARTMENT CONNECTION (FDC)

A. Exposed, Freestanding Fire Department Connection: UL 405, cast brass body with threaded inlets according to NFPA 1963 and matching local fire department hose threads and threaded bottom outlet. Include lugged caps, gaskets and chains; lugged swivel connections and drop clapper for each hose-connection inlet; 18-inch high brass sleeve; and round escutcheon plate. FDC shall have a minimum of four 2-1/2-inch National Hose Thread (NH) and the 6-inch NH connection.
B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:

2.21 UNDERGROUND VAULTS/PITS

A. General: Portland cement concrete, precast or cast-in-place as indicated.

B. Portland Cement Concrete and Reinforcing Steel: Section 03301.

C. Access Openings: As indicated.

D. External Load: Earth load plus AASHTO H20 live load if located in traffic area.

E. Drain: Provide 4-inch minimum diameter drain with either 4-inch minimum diameter solid-pipe connection to underground storm drain system or 12-inch diameter by 3-feet deep dry well filled with drain rock.

2.22 TRACER WIRE

A. General: Minimum #12 AWG stranded copper wire with blue THW, THWN, or THHN rated insulation.

2.23 WARNING TAPE

A. General: See Section 02310.

B. For raw water lines and domestic water lines: Blue color with continuously printed black-letter message reading “CAUTION—WATER LINE BURIED BELOW.”

C. For T22 recycled water lines: Purple color with continuously printed black-letter message reading “CAUTION—RECYCLED WATER LINE BURIED BELOW.”

2.24 PCC THRUST BLOCKS

A. Portland Cement Concrete and Reinforcing Steel: Section 03301. Thrust block design shall be based on NFPA 24, Section 10.8.
PART 3  EXECUTION

3.1  PIPE INSTALLATION

A. General: Install pipe, fittings, and appurtenances utilizing best practices, manufacturer’s instructions, and in accordance with the following:
   1. DIP: AWWA M41 and AWWA C600.
   2. PVC pipe: AWWA M23 and AWWA C605.

B. Pipe Depth and Trench Configuration: Conform to elevations, profiles and typical trench section(s) indicated.

C. Excavation, Bedding, Backfill, and Compaction: Section 2310.

D. Handling: Carefully handle during loading, hauling, unloading and placing operations to avoid breakage or damage. Use strap type slings for lifting and placing; no chains or hooks will be permitted. Comply with manufacturer’s recommendations.

E. Laying: Before lowering pipe into the trench, remove all stakes, debris, loose rock and other hard materials from the bottom of the trench. Lay accurately in conformance with lines and grades indicated. Lay pipe on a bed of bedding material specified and prepared by handwork, dug true to grade. Pipe shall be laid in the trench so that pipe identification information can be easily read prior to backfill. Furnish firm bearing for pipe throughout its entire length with bell holes provided at the ends of each pipe length of sufficient size to permit making up the particular type of joint being used. Adjust pipe to line and grade by scraping away or filling and tamping material under the body of the pipe for the entire pipe length and not by blocking or wedging. After final positioning, hold pipe in place in trench with backfill material placed equally on both sides of the pipe at as many locations as required to hold the pipe section in place.

F. Curved Alignment: When necessary to conform to the alignment specifically indicated, lay pipe on a curved alignment by means of asymmetrical closure of joints or bending of the pipe barrel. If necessary, use shorter than the standard lengths of pipe to achieve curvature specified. Do not exceed the recommendations of the pipe manufacturer for deflections at the joints or pipe bending.

G. Closure: Close open ends of pipes and appurtenance openings at the end of each days work or when work is not in progress.
3.2 CONNECTING TO EXISTING MAINS

A. Pressure Tap Connections: Perform in accordance with the requirements of the owner of the system being tapped. Maintain a positive pressure flow from the main being tapped to the tapping device to flush plastic chips, metal ribbons, etc. into the tapping devise and not into the pipe being tapped.

B. Other Connections: As indicated and in accordance with the requirements of the owner of the line being connected to.

3.3 ANCHORAGE INSTALLATION

A. Mechanically Restrained Joints: Install where indicated for lengths indicated in accordance with manufacturer’s instructions.

B. PCC Thrust Blocks: Install where required and as indicated. Bearing area indicated is to be against undisturbed earth. Allow a minimum of 24-hours curing time before introducing water into the pipeline and allow a minimum of 7-days curing time before pressure testing unless the use of rapid-set concrete or restrained joints is approved in advance by the Owner’s Representative.

3.4 HIGH DEFLECTION FITTINGS/BALL JOINTS, EXPANSION JOINTS, AND FLEXIBLE EXPANSION JOINTS

A. Install as indicated and in accordance with the manufacturers recommendations.

3.5 VALVE INSTALLATION

A. Install all valves in accordance with the manufacturer’s instructions and the following:
   1. General:
      a. Gate Valves: Appendix A of AWWA C509.
   2. Joints:
      b. Valves on Steel Pipe: As indicated for buried locations. Flanged-end valves for installation in vaults/pits.

3.6 SERVICE CONNECTIONS INSTALLATION

A. Install as indicated and in accordance with the requirements of the Owner.
3.7 WATER METER INSTALLATION
   A. Install as indicated and in accordance with the requirements of the Owner.

3.8 FIRE HYDRANT INSTALLATION
   A. Install as indicated and in accordance with the requirements of the DCGC.

3.9 REDUCED-PRESSURE PRESSURE BACKFLOW PREVENTER INSTALLATION
   A. Install as indicated and in accordance with the requirements of DCGC and the local health department requirements.

3.10 DOUBLE CHECK DETECTOR ASSEMBLY INSTALLATION
   A. Install as indicated and in accordance with the requirements of DCGC.

3.11 POST INDICATOR VALVE INSTALLATION
   A. Install as indicated and in accordance with the requirements of DCGC.

3.12 FIRE DEPARTMENT CONNECTION INSTALLATION
   A. Install as indicated and in accordance with the requirements of DCGC.

3.13 UNDERGROUND VAULT/PIT INSTALLATION
   A. Install as indicated.
   B. Excavation and Backfill: Section 02310.

3.14 TRACER WIRE INSTALLATION
   A. Place and secure to top of pipe and fittings at about 3-foot intervals with 6” length of 1” wide filament tape, Scotch brand No. 898 or equal.
   B. Form a mechanically and electrically continuous line throughout the pipeline, extending to the nearest valve or other pipeline appurtenance designated by the owner of the system or the Owner’s Representative. Extend the wire up the outside of the valve box/riser and cut a hole that is 8-inches from the top, extend a 12-inch wire lead to the inside of the box. At other pipeline appurtenances, designated by the owner of the system or the Owner’s Representative, terminate the 12-inch wire lead inside the enclosure.
C. Splice wire with a splicing device consisting of and electro-tin plated seamless copper sleeve conductor. Install as recommended by the manufacturer. Wrap splices and damaged insulation with electrician’s tape.

3.15 WARNING TAPE INSTALLATION

A. Install tape per Section 02310.

3.16 HYDROSTATIC PRESSURE AND LEAKAGE TEST

A. General:
   1. Provide all necessary materials and equipment, including water.
   2. The pipeline shall be center loaded with approved backfill materials with all joints exposed and thrust blocks or other restraining means in place.
   3. Allow time for thrust blocks to cure prior to testing.
   4. Flush all pipes prior to testing to remove all foreign material.flushing shall be per NFPA 24, Section 10.10.2.
   5. Perform pressure and leakage test concurrently.
   6. Test pressure: See Subsection titled “System Performance Requirements.”
   7. Apply test pressure by means of a pump connected to the pipe.
   8. Base test pressure on the elevation of the lowest point in the line.
   9. Fill each closed valve section or bulk-headed section slowly. Expel air from section being tested by means of permanent air vents installed at high points or by means of temporary corporation cocks installed at such points. Remove and plug the temporary corporation cocks at the conclusion of the test.
   10. Allow water to stand in the pipe for 24 hours before test pressure is applied.
   11. Allow the system to stabilize at the test pressure before conducting the leakage test.
   12. Do not operate valves in either the opening or closing direction at differential pressures above the valves rated pressure.
   13. Maintain test pressure as specified for type of pipe being tested. All hydrostatic testing shall comply with NFPA 24, Section 10.10.2.2.
   14. Pressure Test: Examine any exposed pipe, fittings, valves, hydrants and joints during the test, if no leaks are observed the section of line has passed the pressure test. If leaks are observed, repair any damaged or defective pipe, fittings, valves, or hydrants, and repeat the pressure test.
   15. Leakage Test: Perform as specified hereafter for the type of pipe being installed.

B. DIP Leakage Test: Perform in accordance with AWWA C600. Selected requirements of AWWA C600 are repeated as follows:
   1. Maintain the test pressure, +/- 5 psi, for a minimum of two hours.
2. No piping will be accepted if the leakage is greater than that determined by the following formula:

\[ L = \frac{(S \times D \times P^{1/2})}{133,200} \]

- \( L \) = Allowable leakage, gallons per hour.
- \( S \) = Length of pipe tested, feet.
- \( D \) = Nominal diameter of pipe, inches.
- \( P \) = Average test pressure during the leakage test, pounds per square inch (gauge).

C. PE Pipe Leakage Test: [The following leakage test for PE water pipe was taken from the Phillips Petroleum Company (Richardson, TX) (Tel. 800 527 0662) catalog for “Driscopipe.”]

1. Apply the test pressure and allow the pipe to stand, without makeup pressure, for sufficient time to allow for diametric expansion or pipe stretching to stabilize, approximately two to three hours.

2. After the above stabilization has occurred, return the section being tested to the test pressure. Hold the test pressure for one to three hours. If the pressure in the test section drops, and it is determined the drop may be the result of expansion resulting from increasing temperature, a limited amount of additional water may be added to bring the pressure back to the test pressure. Allowable amounts of make-up water, to compensate for expansion due to increasing temperature, are as shown in the following table. Make-up water is only allowed during this final test period and not during the initial stabilization described in the previous paragraph. If the additional water added is less than the allowable shown in the table and there are no visual leaks or significant pressure drops, the tested section passes the test.
### Nominal Pipe Size Allowance for Expansion

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>Allowance for Expansion (U.S. Gals./100 Feet of Pipe)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-Hour Test</td>
</tr>
<tr>
<td>3</td>
<td>0.10</td>
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<tr>
<td>4</td>
<td>0.13</td>
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<td>6</td>
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</tr>
<tr>
<td>40</td>
<td>11.0</td>
</tr>
<tr>
<td>48</td>
<td>15.0</td>
</tr>
</tbody>
</table>

### PVC Pipe Leakage Test

Perform in accordance with AWWA M23. Selected requirements of AWWA M23 are repeated as follows:

1. Maintain the test pressure, +/- 5 psi, for a minimum of two hours.
2. Leakage:
   a. For all domestic water lines and any T22 recycled water line or raw water line which also serves as a fire line, there is no acceptable leakage rate for PVC pipe per NFPA 24, Section 10.10.2.2.4.
   b. For all other T22 recycled water lines or raw water lines that will not serve as fire lines, no piping will be accepted if the leakage is greater than that determined by the following formula:

   \[
   L = \frac{(N \times D \times P^{1/2})}{7,400}
   \]

   L = Allowable leakage, gallons per hour.
   N = Number of joints in the length of the pipeline tested.
   D = Nominal diameter of pipe, inches.
   P = Average test pressure during the leakage test, pounds per square inch (gauge).
E. Cement Mortar Lined and Coated Steel Pipe Leakage Test: Perform in accordance with AWWA M11. Selected requirements of AWWA M11 are repeated as follows:
1. Maintain the test pressure, +/- 5 psi, for a minimum of two hours.
2. There shall be no significant leakage for pipe with welded joints or mechanical couplings.
3. For pipe joined with O-ring rubber gaskets, a leakage of 25 gallons per inch of diameter per mile per 24-hours is allowed.

3.17 DISINFECTION

A. All New Pipelines shall be disinfected in accordance with one of the three methods specified in AWWA C651 and the following:
1. Disinfect after pressure and leakage test have been performed and accepted.
2. The method used shall be at the Contractor’s option, unless specified by the owner of the water system.
3. Engage the services of a commercial testing laboratory, approved by the owner of the water system, to perform the bacteriological tests specified in Section 5.1 of AWWA C651. Direct the testing laboratory to send the original report of the bacteriological testing to the owner of the water system. Should the laboratory report show that any sample taken was not acceptable, repeat the sterilization process shall until a satisfactory sterilization is accomplished.
4. Lawfully dispose of the chlorinated water.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roadway and/or site sanitary gravity sewers and force mains up to 5 feet of any on-site building.

1.2 RELATED SECTIONS

A. Section 02310, Utility Trenching and Backfill.

B. Section 03301, Minor Concrete

1.3 RELATED DOCUMENTS

A. AASHTO:
   1. M 199: Precast Reinforced Concrete Manhole Sections.

B. ASTM:
   1. A 615/A615M: Deformed and Billet-Steel Bars for Concrete Reinforcement.
   2. A 674 Practice for Polyethylene Encasement for Ductile Iron Pipe for Water and Other Liquids.
   7. D 1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
12. D 3034: Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

C. AWWA:
3. C110: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm) for Water.

D. Caltrans Standard Specifications.
1. Section 51, Concrete Structures.
2. Section 65, Reinforced Concrete Pipe
3. Section 75 Miscellaneous Metal.

1.4 DEFINITIONS

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


E. HDPE: High-density polyethylene.

F. PE: Polyethylene.

G. DIP: Ductile iron pipe.

H. PVC: Polyvinyl Chloride.
I. RCP: Reinforced concrete pipe.

J. NPS: Nominal pipe size.

1.5 SUBMITTALS

A. Follow submittal procedure outlined in Section 01330.

B. Product data for the following:
   1. Piping materials and fittings.
   2. Special pipe couplings.
   4. Cleanout plugs or caps.
   5. Sewage air relief valves.

C. Shop drawings: Include plans, elevations, details and attachments for the following:
   1. Precast concrete manholes, frames and covers.
   2. Precast concrete clean out boxes and box covers.
   3. Force main piping access openings.

D. Design Mix Reports and Calculations: For each class of cast in place concrete.

E. Field Test Reports: Indicate and interpret test results for compliance with performance.

1.6 DELIVERY, STORAGE AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.

B. Protect pipe, fittings, and seals from dirt and damage.

C. Handle precast concrete pipe, manholes and other precast structures according to manufacturer’s written instructions.

D. Protect imported bedding and backfill material from contamination by other materials.

PART 2 PRODUCTS

2.1 PIPING MATERIALS FOR GRAVITY FLOW

A. DIP: Sizes 4-inch through 48-inch.
   2. Pressure Class: Minimum pressure class for size indicated.
3. Fittings
   a. Standard: AWWA C110, sizes 4-inch through 48-inch.
   b. Compact: AWWA C153, sizes 4-inch through 24-inch.

4. Pipe and Fitting Lining: Cement Mortar, AWWA C104.

5. Pipe and Fitting Coating: Asphalitic, AWWA C151 or C115.

6. Joints:
   a. Push-On Bell and Spigot Joint: AWWA C111.
   b. Mechanical Joint: AWWA C111.
   c. Flanged joint: AWWA C115.

B. PE Pipe and Fittings (HDPE): 4-inch through 10-inch, AASHTO M252 Type S, smooth interior and corrugated exterior. Bell and spigot joints.
   2. Couplings: AASHTO M 252, corrugated band type, engage a minimum of 4 corrugations, 2 on each side of pipe joint.

   2. Couplings: AASHTO M 252, corrugated band type, engage a minimum of 4 corrugations, 2 on each side of pipe joint.

D. PVC Pipe:
   1. Pipe:
      a. 4-inch through 15-inch: ASTM D 3034, SDR 35. Bell and spigot joints.
      b. 18 inch through 36-inch: ASTM F 679, T-1 wall. Bell and spigot joints.
   2. Fittings:
      a. 4-inch through 27-inch: ASTM F 1336.
      b. 30-inch through 36-inch: ASTM D 3034, SDR 35

2.2 PIPING MATERIALS FOR FORCE MAINS

A. DIP: See Section 02510.

B. PE Pipe: See Section 02510.

C. PVC Pipe: See Section 02510.
2.3 SPECIAL PIPE COUPLINGS

A. Gravity Piping: ASTM C 1173. Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.

B. Force Main piping: See Section 02510.

2.4 GRAVITY PIPE CLEANOUTS

A. Piping: Same as sanitary sewer line if possible.

B. Top Cap: Threaded and of same material as piping if possible.

C. Box Size: As required to provide access and allow easy removal and reinstallation of cap.

D. Box Types:
   2. Traffic Areas: Portland cement concrete box and box cover or steel or cast iron cover, heavy duty, both box and cover to be rated for AASHTO H20 loading.

E. Box Cover Markings: “S.S.,” unless otherwise specified.

F. Available Manufacturers: Subject to compliance with requirements, box manufacturers offering products that may be incorporated into the Project include, but are not limited to the following:
   1. Associated Concrete Products, Inc. (Santa Ana, California) (Tel. 714-557-7470).
   2. Brooks Products Inc. (El Monte, California) (Tel. 818-443-3017).
   3. Christy Concrete Products, Inc. (Fremont, California) (Tel. 800-486 7070).

2.5 MANHOLES

A. General: Size, shape, configuration, depth, etc. of manhole and frame and cover shall be as indicated.

B. Portland Cement Concrete and Reinforcing:
   1. Poured-in-Place Portion: Section 03301.
   2. Precast Portion: ASTM C 478. Rate for AASHTO H20 loading in traffic areas.

C. Frames and Covers: As indicated and in accordance with Caltrans Standard Specification Section 75-1.02.
D. Steps: Manufacture from deformed, ½-inch steel reinforcement rod complying with ASTM A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, (Milpitas, CA) (Tel 408-262-1091) or equal.

E. Force Main Piping Access Openings:
   1. General: As indicated.

2.6 JOINT SEALANT FOR STRUCTURES AND MANHOLES

   1. Use to seal around pipes at connections to structures and manholes. Also use to seal joints between precast sections of structures and manholes.

B. Gaskets: Preformed flexible rubber or plastic gasket.
   2. Plastic Gaskets: Federal Specification SS-S-00210 (GSA-FSS), Type I, Rope Form; or alternate standard which may exist. Acceptable material is “Ram-Nek,” as manufactured by the K. T. Snyder Company (Houston TX), or equal.

2.7 SEWAGE AIR RELIEF VALVE ASSEMBLY FOR FORCE MAINS

A. General: As indicated.

2.8 THRUST BLOCKS FOR FORCE MAINS

A. General: Location, configuration bearing area, etc. as indicated.

B. Portland Cement Concrete: Section 03301.

PART 3 EXECUTION

3.1 GRAVITY PIPE INSTALLATION

A. General: Install pipe, fittings, and appurtenances utilizing best practices, manufacturer’s instructions, and in accordance with Section 6 and 7 of ASTM D 2321 for plastic pipe, Caltrans Standard Specification Section 65-1.07 for reinforced concrete pipe and chapter 11.3.3 of AWWA M41 for ductile iron pipe.

B. Pipe Depth and Trench Configuration: Conform to typical trench section(s) indicated.
C. Excavation, Bedding, Backfill, and Compaction: Section 2310.

D. Handling: Carefully handle during loading, hauling, unloading and placing operations to avoid breakage or damage. Use strap type slings for lifting and placing; no chains or hooks will be permitted. Comply with the manufacturer’s recommendations.

E. Laying: Before lowering pipe into the trench, remove all stakes, debris, loose rock and other hard materials from the bottom of the trench. Lay accurately in conformance with lines and grades indicated. Start laying the pipeline at the low end and proceed upstream. Lay bell and spigot pipe with the bell end facing upstream. Lay pipe on a bed prepared by handwork, dug true to grade. Furnish firm bearing for pipe throughout it’s entire length with bell holes provided at the ends of each pipe length of sufficient size to permit making up the particular type of joint being used. Adjust pipe to line and grade by scraping away or filling and tamping material under the body of the pipe for the entire pipe length and not by blocking or wedging. After final positioning, hold pipe in place in trench with backfill material placed equally on both sides of the pipe at as many locations as required to hold the pipe section in place.

F. Curved Alignment: When necessary to conform to the alignment specifically indicated, lay pipe on a curved alignment by means of asymmetrical closure of joints or bending of the pipe barrel. Use shorter lengths of pipe than the standard length if necessary to achieve curvature specified. Do not exceed the recommendations of the pipe manufacture for deflections at the joints or pipe bending.

G. Closure: Close open ends of pipes and appurtenance at the end of each days work or when work is not in progress.

3.2 FORCE MAIN PIPE INSTALLATION

A. General: See Section 2510.

3.3 SPECIAL PIPE COUPLINGS

A. General: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

B. Installation: Manufacturers instructions.

3.4 CLEANOUT INSTALLATION

A. General: Install as indicated.
3.5 MANHOLE INSTALLATION

A. General: Install as indicated.

3.6 AIR RELIEF VALVE ASSEMBLY INSTALLATION

A. General: Install as indicated.

3.7 TESTING OF GRAVITY PIPING MAINS

A. Obstructions: After backfilling and compacting, but before paving or other surface improvements, test sewer for obstructions either by rodding or by the sewer ball method. Provide for intercepting all grit, rocks and other flushed debris to keep debris from entering the existing system.

B. Conduct a video inspection and provide documentation on a DVD for all sewer mains.

C. At the option of the Contractor, either the following hydrostatic or air test shall be performed.

D. Hydrostatic Test:
   1. Test after backfilling to finish grade or pavement structural section subgrade in paved areas.
   2. Test sewer mains between successive manholes by closing the lower end of the sewer main to be tested and the inlet sewer main of the upper manhole with stoppers.
   3. Fill pipe and manholes with water to a point four feet below the ground surface of the upper manhole, but in no case less than four feet above the pipe invert. If ground water is present, the water surface at the upper manhole shall be at least four feet above the level of the ground water.
   4. Fill piping at least one hour prior to testing.
   5. Test piping at least two hours by maintaining the head specified above with measured additions of water. The sum of these additions of water, in the two-hour test period, shall be the leakage amount.
   6. The maximum allowable head of water above any portion of sewer being tested shall be 15-feet. Where the difference in elevation between successive manholes exceeds 15-feet, a test tee shall be installed between manholes, and the testing shall be carried on between the tee and the manhole.
   7. The allowable leakage shall not exceed 0.1-gallons per minute per inch diameter, per 1000-feet of sewer main being tested.
8. If the leakage exceeds the above amount, determine the cause and remedy it prior to retesting.
9. If the leakage is less than the allowable, but leaks are observed, repair the observed leaks.

E. Air Test:
1. Test after backfilling to finish grade or pavement structural section subgrade in paved areas.
2. Apply to each length between adjacent manholes.
3. Supply pressure gauge with minimum divisions of 0.10-psi and with an accuracy of +/- 0.04-psi. When requested by the Owner’s Representative, provide certification that the gauge has been tested for accuracy within the last six months by a reliable testing firm.
4. Pressurize the test section to 3.5-psi, and then hold the pressure above 3.0-psi during a saturation period of at least 5 minutes. At the end of the saturation period, note the pressure, which must be a minimum of 3.0-psi, and begin the timed period. If the pressure drops 0.5-psi in less than the time given in the following table the section of pipe has not passed the test.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Minimum Time Allowed for Pressure to Drop 0.5-PSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>4”</td>
<td>125 seconds</td>
</tr>
<tr>
<td>6”</td>
<td>185 seconds</td>
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<tr>
<td>36”</td>
<td>18 minutes</td>
</tr>
<tr>
<td>42”</td>
<td>20 minutes</td>
</tr>
<tr>
<td>48”</td>
<td>23 minutes</td>
</tr>
<tr>
<td>54”</td>
<td>26 minutes</td>
</tr>
</tbody>
</table>

5. If the time for the pressure to drop 0.5-psi is 125% or less of the time indicated, the line shall immediately be re-pressurized to 3.0-psi and the test repeated. If, during the 5-minute saturation period, the pressure drops less than 0.5-psi after the initial pressurization and air is not added, the section undergoing the test shall have passed.
6. If the test did not pass, find and repair the leak to the satisfaction of the Owner’s Representative.
7. When the prevailing ground water is above the line being tested the air pressure shall be increased 0.43-psi for each foot the water table is above the invert of the pipe at the highest manhole.

3.8 TESTING OF LATERALS

A. At the option of the Contractor, either the following hydrostatic or air test shall be performed.

B. Hydrostatic Test:
   1. Test laterals before backfilling.
   2. Plug lateral at its ends and fill with water through the cleanouts.
   3. Maintain the water level in the cleanouts as high as possible throughout the test period.
   4. One hour after filling with water, examine the lateral for leakage.
   5. Repair all leaks to the satisfaction of the Owner’s Representative.
   6. Do not backfill the trench until testing and repairs of the lateral are complete, and approved by the Owner’s Representative.
   7. Following approval of the Owner’s Representative, remove all plugs, dispose of the water and complete the connection to the main.

C. Air Test
   1. Test after backfilling to finish grade or pavement structural section subgrade in paved areas.
   2. Test in accordance with subsection above titled “Testing of Gravity Piping Mains,” paragraph titled “Air Test.”

3.9 TESTING OF MANHOLES ON GRAVITY LINES

A. At the option of the Contractor, either the following hydrostatic or vacuum test shall be performed.

B. Hydrostatic Test:
   1. Insert inflatable plugs in all sewer inlets and outlets.
   2. Fill the manhole with water to a point six inches below the base of the manhole frame.
   3. Maintain the water at this point for one hour to allow time for absorption.
   4. Begin one-hour test period. Measure the amount of water added in one-hour period to maintain the water level at six inches below the base of the manhole frame. Do not allow water level to drop more than 25% of the manhole depth.
   5. Determine the allowable leakage by the following formula.

\[ L = 0.0002 \times D \times H^{1/2} \]
L = Allowable leakage, gallons per minute.
D = Depth of manhole from top to bottom, feet.
H = Head of water in feet as measured from the surface of the water in the
manhole to the sewer line invert or to the prevailing ground water surface outside
the manhole. The lesser height governs.

6. If the leakage exceeds the allowable, determine the cause, take remedial action
and re-test the manhole. If the leakage is less than the allowable and leaks are
observed, repair the leaks.

C. Vacuum Test:
1. General: Test in accordance with ASTM C 1244.
2. Test prior to backfilling around the manhole.
3. Test Preparation: Plug all lift holes and pipes entering or exiting the manhole.
4. Place test head inside the top section of the manhole’s cone section and inflate in
accordance with the manufacturers instructions.
5. Draw a vacuum of 10-inches of mercury and shut the pump off.
6. With the valve closed, the time for the vacuum to drop 9-inches shall be
measured.
7. The manhole shall pass the test if the time is greater than 60 seconds for a 48-
inches diameter manhole, 75 seconds for a 60-inch diameter manhole and 90
seconds for a 72-inch diameter manhole.
8. If the manhole fails the initial test, make necessary repairs with a non-shrink
grout while the vacuum is still being drawn. Retest until a satisfactory test is
obtained.

3.10 HYDROSTATIC AND LEAKAGE TESTING OF FORCE MAINS

A. General: Perform hydrostatic and leakage test in accordance with Section 02510.

END OF SECTION
SECTION 02620
SUBDRAINAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Subdrains in trenches and subdrains or prefabricated composite drainage panels at walls or foundations.

1.2 RELATED SECTIONS

A. Section 02310, Utility Trenching and Backfill.

B. Section 02630, Storm Drainage.

1.3 RELATED DOCUMENTS

A. AASHTO:
   1. M 252: Corrugated Polyethylene Drainage Tubing.

B. ASTM:
   2. D 448: Classification for Sizes of Aggregate for Road and Bridge Construction.
   4. D 1785: Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   10. D 3034: Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

C. Caltrans Standard Specifications:
   1. Section 68-Subsurface Drains
   2. Section 88-Engineering Fabrics.

1.4 DEFINITIONS

A. AASHTO: American Association of State Highway and Transportation Officials.
B. ABS: Acrylonitrile-Butadiene-Styrene.
C. ASTM: American Society for Testing and Materials
E. HDPE: High-density polyethylene.
F. PE: Polyethylene.
G. PVC: Polyvinyl Chloride.

1.5 SUBMITTALS

A. Follow submittal procedure outlined in Section 01330.
B. Product data for the following:
   1. Perforated pipe and fittings.
   2. Solid pipe and fittings.
   3. Prefabricated composite drainage panels.
   5. Cleanout plugs or caps.
   6. Precast clean out boxes and box covers.
C. Samples:
   1. Drainage Fill.

1.6 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  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.
   2. Couplings: AASHTO M 252, corrugated band type. Engage a minimum of 4 corrugations, 2 on each side of pipe joint.

B. PE Pipe and Fittings (HDPE): 12-inch through 48-inch, AASHTO M 294.Type S (Solid Wall.) or Type SP (Perforated wall.), smooth interior and corrugated exterior. Bell and spigot joints.
   2. Couplings: AASHTO M 252, corrugated band type. Engage a minimum of 4 corrugations, 2 on each side of pipe joint.

   1. Solvent Cement: ASTM D 2564. Include primer according to ASTM F656.

D. PVC Pipe and Fittings:
   3. Fittings: ASTM F 1336.

2.2 SPECIAL PIPE COUPLINGS

A. Description: ASTM C 1173. Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.

2.3 CLEANOUTS

A. Piping: Same as subdrain pipe without perforations.
B. Top Plug or Cap: Same material as piping if possible. Plug or cap to be secure but removable, threaded or non-threaded.

C. Size box to provide access and allow easy removal and reinstallation of plug or cap.

D. Types:
   2. Traffic Areas: Portland cement concrete box and box cover or steel or cast iron cover, heavy duty, both box and cover to be rated for AASHTO H20 loading.

E. Cover Markings: “S.D.,” unless otherwise specified.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
   1. Associated Concrete Products, Inc. (Santa Ana, California) (Tel. 714-557-7470).
   2. Brooks Products Inc. (El Monte, California) (Tel. 818-443-3017).
   3. Christy Concrete Products, Inc. (Fremont, California) (Tel. 800-486-7070).

2.4 DRAINAGE FILL MATERIAL


B. Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate, Sieve No. 57, with 100 percent passing 1-1/2-inch sieve and not more than 5 percent passing No. 8 sieve.

2.5 FILTER FABRIC

A. When required, use filter fabric for encasing permeable material around subdrains.
   2. Mirifi 140N (Mirifi Inc., Charlotte, NC) (Tel. 800-438-1855) or equal.

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.

3.4 INSTALLATION OF NON-PERFORATED PORTIONS OF SUBDRAINS

A. Conform to Sections 02310 and 02630.
3.5 JOINING PIPE

A. Join ABS and PVC pipe and fittings with elastomeric seals according to ASTM D 2321 or solvent cement.

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 CLEANOUT INSTALLATION

A. Cleanout piping to be the same size as the subdrain piping to which it is attached.

B. Install cleanouts from subdrainage piping to grade. Locate cleanouts at beginning of piping run, at changes in direction, and other locations indicated.

C. Do not allow cleanout box to bear on cleanout riser.

3.7 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
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roadway and/or site storm drainage up to 5-feet of any on-site building.

1.2 RELATED SECTIONS

A. Section 02310, Utility Trenching and Backfill.

B. Section 02620, Subdrainage.

C. Section 03301, Minor Concrete.

1.3 RELATED DOCUMENTS

A. AASHTO:
   1. M 199: Precast Reinforced Concrete Manhole Sections.

B. ASTM:
   2. A 615/A615M: Deformed and Billet-Steel Bars for Concrete Reinforcement.
   3. A 716: Ductile Iron Culvert Pipe
   4. A 746: Ductile Iron Gravity Sewer Pipe
   10. D 1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
15. D 3034: Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
17. F 477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. AWWA:
3. C110: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm) for Water.

D. Caltrans Standard Specifications:
1. Section 51, Concrete Structures.
2. Section 52, Reinforcement.
3. Section 65, Reinforced Concrete Pipe.
4. Section 66, Corrugated Metal Pipe.
5. Section 70. Miscellaneous Facilities.
6. Section 72, Slope Protection.
7. Section 75 Miscellaneous Metal.

E. Caltrans Standard Plans:
1. Plan D94A: Metal and Plastic Flared End Sections.
2. Plan D94B: Concrete Flared End Sections.
3. Plan D97A: Corrugated Metal Pipe Coupling Details No.1, Annular Coupling Band Bar and Strap and Angle Connection.
4. Plan D97B: Corrugated Metal Pipe Coupling Details No. 2, Hat Band Coupler and Flange Details.
5. Plan D97C: Corrugated Metal Pipe Coupling Details No. 3, Helical and Universal Couplers.
6. Plan D97D: Corrugated Metal Pipe Coupling Details No. 4, Hugger Coupling Bands.
7. Plan D97E: Corrugated Metal Pipe Coupling Details No. 5, Standard Joint.
8. Plan D97F: Corrugated Metal Pipe Coupling Details No. 6, Positive Joint.
11. Plan D98B: Slotted Corrugated Steel Pipe Drain Details.

1.4 DEFINITIONS

A. AASHTO: American Association of State Highway and Transportation Officials.
E. CMP: Corrugated metal pipe.
F. DIP: Ductile iron pipe.
G. HDPE: High-density polyethylene.
H. NPS: Nominal pipe size.
I. PE: Polyethylene.
J. PVC: Polyvinyl chloride.
K. RCP: Reinforced concrete pipe.

1.5 SUBMITTALS

A. Follow submittal procedure outlined in Section 01330.
B. Product Data Shop Drawings, Etc.: For the following:
   1. Piping materials and fittings.
   2. Special pipe couplings.
   3. Polymer-concrete, channel drainage systems (trench drains).
   4. Joint sealants.
   5. Plastic area drains.
   6. Cleanout plugs or caps.
7. Precast concrete catch basins, inlets, curb inlets, junction structures and area drains, including frames and grates.
8. Precast clean out boxes and box covers.
9. Concrete, metal and plastic flared end sections.

Design Mix Reports and Calculations: For each class of cast in place concrete.

Field Test Reports: Indicate and interpret test results for compliance with performance.

1.6 DELIVERY, STORAGE AND HANDLING

Do not store plastic structures, pipe and fittings in direct sunlight.

Protect pipe, fittings, and seals from dirt and damage.

A. Handle precast concrete pipe, manholes and other precast structures according to manufacturer’s written instructions.

Protect imported bedding and backfill material from contamination by other materials.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

A. Reinforced Concrete Pipe: Designated by Class, rubber gasketed joints.
   2. Oval shaped (Elliptical) Reinforced Concrete Pipe: Caltrans Standard Specification Section 65-1.02B. Class HE-III and VE-III unless otherwise noted on Plans.
   3. Reinforced Concrete Pipe Arch: Caltrans Standard Specification Section 65-1.02C.

B. PE Pipe and Fittings: 4-inch through 10-inch, AASHTO M 252, Type S, smooth interior and corrugated exterior. Bell and spigot joints.
   2. Couplings: AASHTO M 252, corrugated band type. Engage a minimum of 4 corrugations, 2 on each side of pipe joint.

2. Couplings: AASHTO M 294, corrugated band type. Engage a minimum of 4 corrugations, 2 on each side of pipe joint.

D. PVC Pipe and Fittings - Smaller than 4-Inch: ASTM D1785, Schedule 40.
1. Joints: Solvent Cement, ASTM D 2564. Include primer according to ASTM F656.

E. PVC Pipe and Fittings, 4-Inch and Larger
1. Pipe:
   a. 4-inch through 15-inch: ASTM D 3034, SDR 35. Bell and spigot joints.
   b. 18 inch through 36-inch: ASTM F 679, T-1 wall. Bell and spigot joints.
2. Fittings:
   a. 4-inch through 27-inch: ASTM F 1336.
   b. 30-inch through 36-inch: ASTM D 3034, SDR 35

2.2 PIPE ANCHORS

A. Portland Cement Concrete and Reinforcing: Section 03301.

2.3 SPECIAL PIPE COUPLINGS

A. Plastic, Cast Iron and Ductile Iron Pipe: ASTM C 1173. Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.
B. Reinforced Concrete Pipe: Portland cement collar as indicated.

2.4 CLEANOUTS

A. Piping: Same as storm drain line if possible.
B. Top Plug or Cap: Same material as piping if possible. Plug or cap to be secure but removable, threaded or non-threaded.
C. Box Size: As required to provide access and allow easy removal and reinstallation of plug or cap.
D. Box Types:
   2. Traffic Areas: Portland cement concrete box and box cover or steel or cast iron cover, heavy duty, both box and cover to be rated for AASHTO H20 loading.
E. Box Cover Markings: “S.D.,” unless otherwise specified.

F. Available Manufacturers: Subject to compliance with requirements, box manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
   1. Associated Concrete Products, Inc. (Santa Ana, California) (Tel. 714-557-7470).
   2. Brooks Products Inc. (El Monte, California) (Tel. 818-443-3017).
   3. Christy Concrete Products, Inc. (Fremont, California) (Tel. 800-486-7070).

2.5 CURB INLETS, CATCH BASINS, DROP INLETS, JUNCTION STRUCTURES, AREA DRAINS, ETC.

A. General: Size, shape, configuration, depth, etc. of structure and frame, grate, or cover shall be as indicated.

B. Portland Cement Concrete and Reinforcing: Section 03301.

C. Precast Structure: Rate for AASHTO H20 loading in traffic areas.

D. Steps: ASTM C 478 or AASHTO M 199. Manufacture from deformed, ½-inch steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, (Milpitas, CA) (Tel 408-262-1091).

E. Frames, Grates and Covers: Caltrans Standard Specification Section 75-1.02, 75-1.03 and 75-1.05.
   1. Galvanize steel frames, grates and covers.
   2. Grates and covers shall be non-rocking.
   3. Rate for AASHTO H20 loading in traffic areas.

2.6 MANHOLES

A. General: Size, shape, configuration, depth, etc. of manhole and frame and cover shall be as indicated.

B. Portland Cement Concrete and Reinforcing:
   1. Poured-in-Place Portion: Section 03301.
   2. Precast Portion: ASTM C 478 or AASHTO M199. Rate for AASHTO H20 loading in traffic areas.
C. Frames and Covers: As indicated and in accordance with Caltrans Standard Specification Section 75-1.02.

D. Steps: Manufacture from deformed, ½-inch steel reinforcement rod complying with A 615/A 615M and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, (Milpitas, CA) (Tel 408-262-1091) or equal.

2.7 JOINT SEALANT FOR PRECAST STRUCTURES AND MANHOLES

   1. Use to seal around pipes at connections to structures and manholes. Also use to seal joints between precast sections of structures and manholes.

B. Gaskets: Preformed flexible rubber or plastic gasket.
   2. Plastic Gaskets: Federal Specification SS-S-00210 (GSA-FSS), Type I, Rope Form; or alternate standard which may exist. Acceptable material is “Ram-Nek” as manufactured by the K. T. Snyder Company (Houston TX) or equal.

2.8 POLYMER-CONCRETE TRENCH DRAINS

A. General: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include number of units required to form total length required.

B. Include the following components:
   1. Channel Sections: Interlocking-joint, precast modular units with end caps. Inside width as indicated with deep, rounded bottom, with built in slope or flat invert as indicated and outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
   2. Frame and Grate: Gray iron, ductile iron or galvanized steel as indicated. Where drain is located in traffic areas, rate for AASHTO H20 loading.

C. Locking Mechanism: Manufacturer’s standard device for securing grates to channel sections.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
   1. “Polydrain” by ABT Inc. (Troutman, NC) (Tel 704-528-9806).
   2. “ACO Drain” by ACO Polymer Products Inc. (Chardon, OH) (Tel. 800-543-4764).
2.9 METAL, CONCRETE OR PLASTIC FLARED END SECTIONS

A. General: Caltrans Standard Specification Section 70-1.02C and Caltrans Standard Plan D94A and D94B.

2.10 SLOPE PROTECTION

   1. Class: As shown on the Plans.

B. Concrete/Shotcrete Slope Protection: Caltrans Standard Specification Section 72-4.03.
   2. Welded Wire Fabric: Caltrans Standard Specification Section 52-1.02C. Use 6 x 6-W1.4 xW1.4 unless otherwise indicated on the Plans.

   1. Class: As shown on the Plans.

D. Sacked Concrete Slope Protection.
   1. Concrete: Section 03301, Class C.
   2. Sacks: 10 ounce burlap measuring approximately 19.5-inches by 36 inches when empty and laid flat.

2.11 CONCRETE/SHOTCRETE DITCH LINING

A. General: Caltrans Standard Specification Section 72-4.03.
   2. Welded Wire Fabric: Caltrans Standard Specification Section 52-1.02C. Use 6 x 6-W1.4 xW1.4 unless otherwise indicated.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

A. General: Install pipe, fittings, and appurtenances utilizing best practices, manufacturer’s instructions, and in accordance with Section 6 and 7 of ASTM D 2321 for plastic pipe, Caltrans Standard Specification Section 65-1.07 for reinforced concrete pipe, Caltrans Standard Specification Sections 66-1.045 and 66-105 for

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corrugated metal pipe and chapter 11.3.3 of AWWA M41 for cast iron and ductile iron pipe.

B. Pipe Depth and Trench Configuration: Conform to typical trench section(s) indicated.

C. Excavation, Bedding, Backfill, and Compaction: Section 2310.

D. Handling: Carefully handle during loading, hauling, unloading and placing operations to avoid breakage or damage. Use strap type slings for lifting and placing; no chains or hooks will be permitted. Comply with manufacturer’s recommendations.

E. Laying: Before lowering pipe into the trench, remove all stakes, debris, loose rock and other hard materials from the bottom of the trench. Lay accurately in conformance with lines and grades indicated. Start laying the pipeline at the low end and proceed upstream. Lay bell and spigot pipe with the bell end facing upstream. Lay pipe on a bed prepared by handwork, dug true to grade. Furnish firm bearing for pipe throughout it’s entire length with bell holes provided at the ends of each pipe length of sufficient size to permit making up the particular type of joint being used. Adjust pipe to line and grade by scraping away or filling and tamping material under the body of the pipe for the entire pipe length and not by blocking or wedging. After final positioning, hold pipe in place in trench with backfill material placed equally on both sides of the pipe at as many locations as required to hold the pipe section in place.

F. Curved Alignment: When necessary to conform to the alignment specifically indicated, lay pipe on a curved alignment by means of asymmetrical closure of joints or bending of the pipe barrel. Use shorter lengths of pipe than the standard length if necessary to achieve curvature specified. Do not exceed the recommendations of the pipe manufacture for deflections at the joints or pipe bending.

G. Closure: Close open ends of pipes and appurtenance openings at the end of each days work or when work is not in progress.

3.2 INSTALLATION OF PIPE ANCHORS

A. Install at location, configuration and details shown on the Plans.

3.3 SPECIAL PIPE COUPLINGS

A. General: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
B. Installation: Manufacturer’s instructions.

3.4 CLEANOUT INSTALLATION

A. General: Install as indicated.

3.5 INSTALLATION OF CURB INLETS, CATCH BASINS, DROP INLETS, JUNCTION STRUCTURES, AREA DRAINS, ETC. AND MANHOLES

A. Excavation, Bedding, Backfill, and Compaction: Section 2310.

B. Poured in Place Structures: Install as indicated and Caltrans Standard Specification Section 51.
   1. Shape bottoms to convey flows as indicated.

C. Precast Structures: Install as indicated.
   1. Seal all joints and pipe entrances and exits.
   2. Place concrete in bottom and shape to convey flows as indicated.

3.6 POLYMER-CONCRETE TRENCH DRAIN INSTALLATION

A. Excavation, Bedding, Backfill, and Compaction: Section 2310.

B. Install: As indicated and in accordance with the manufacturer’s instructions.

3.7 CONCRETE OR PLASTIC FLARED END SECTION INSTALLATION

A. Install: As indicated.

3.8 SLOPE PROTECTION PLACEMENT

A. Rock Slope Protection: Caltrans Standard Specification Section72-2.03 and as indicated.
   1. Use Method B Placement unless otherwise indicated.

B. Concrete/Shotcrete Slope Protection: Caltrans Standard Specification Section 72-4.02 and 72-4.04.

C. Concreted-Rock Slope Protection: Caltrans Standard Specification Section 72-5.03 and 72-5.04.
   1. Use Method B Placement unless otherwise indicated.
D. Sacked Concrete Slope Protection.
   1. Detailed configuration: As indicated.
   2. Use one cubic foot of concrete per sack.
   3. Locate headers and stretchers as indicated.
   5. Stretchers: Folded ends are not to be adjacent.
   6. Place no more than four vertical courses until initial set has taken place in first course.

3.9 CONCRETE/SHOTCRETE DITCH LINING PLACEMENT

A. Concrete/Shotcrete Slope Protection: Caltrans Standard Specification Section 72-4.02 and 72-4.04.

END OF SECTION
SECTION 02735

DECOMPOSED GRANITE PAVING

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

A. Requirements of "General Conditions of the Contract" and of Division 1, "General Requirements", apply to work in this Section with same force and effect as though repeated in full herein.

1.02 SCOPE OF WORK

A. Furnish materials, labor, transportation, services, and equipment necessary to install decomposed granite paving as indicated on Drawings and as specified herein.

B. Work included in this Section:
   1. Decomposed granite paving with Stabilizer binder additive.

C. Work related in other Sections:
   1. Section 02810 – Landscape Irrigation
   2. Section 02810-A – Landscape Irrigation
   3. Section 02900 - Landscape Planting: Coordination of planting along edges of decomposed granite paving and composite header.

1.03 REFERENCES


1.04 SYSTEM DESCRIPTION

A. Decomposed granite paving with Stabilizer binder additive and polypropylene fibers for strength.

1.05 SUBMITTALS

A. In accordance with Division 1.

B. Submit specification data Cut Sheets for products specified under this Section.

C. Products: Five pound sample and sieve analysis for grading of decomposed granite.
1.06 TESTS

A. Perform gradation of decomposed granite material in accordance with ASTM C 136.

1.07 MOCK-UPS

A. Install a 4-foot wide x 10-foot long mock-up of decomposed granite paving with Stabilizer additive at location as directed by Owner’s Authorized Representative.

B. This mock-up will be the standard from which future work will be judged.

C. Remove Mock-up completely prior to Final Payment.

1.08 ENVIRONMENTAL CONDITIONS

A. Do not install decomposed granite paving during rainy conditions.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

A. In accordance with Division 1.

B. Cover Stabilizer binder with plastic covering to prevent exposure to rainfall, debris, or removal by wind.

1.10 COORDINATION

A. Notify contractor’s related to installation of his work in ample time, so as to allow sufficient time for those contractors to perform their portion of work.

1.11 QUALITY ASSURANCE

A. Installer: Provide evidence to indicate successful experience in providing decomposed granite paving containing Stabilizer binder additive.
   1. Experience: Minimum 5 years.

1.12 INSPECTION OF SITE

A. Verify conditions at site that affect Work of this Section, and take field measurements as required. Report major discrepancies between Drawings and field dimensions to Owner’s Authorized Representative prior to commencing Work.
1.13 EXCESS MATERIALS

A. Provide Owner’s Authorized Representative with the following excess materials for use in future decomposed granite paving repair:
   1. Four, 40 lb. bags of decomposed granite screenings with source location provided.
   2. Two, 40 lb. bags of Stabilizer additive.

PART 2 - PRODUCTS

2.01 DECOMPOSED GRANITE SCREENINGS

A. Washed, natural-colored crushed granite stone, free of clay, friable materials and debris and graded in accordance with ASTM C 136 within the following limits:

   1. Gradation: As determined by ASTM C-136 methodology:

      | Sieve Size | Percent Passing |
      |------------|----------------|
      | ½”         | 95 - 100       |
      | 3/8”       | 90 - 100       |
      | No. 4      | 50 - 100       |
      | No. 30     | 25 to 55       |
      | No. 100    | 10 to 20       |
      | No. 200    | 5 - 18         |

   2. Sand Equivalent: As determined by ASTM D-2419 methodology. Shall have a minimum of 30.
   3. R-Value: As determined by ASTM D-2488 methodology. Shall have a minimum of 70.

B. Acceptable Local Supplier:
   1. Gail Materials (951) 279-1095, “Pyrite Gold” or approved local (Gold color) equal. Provide submittal sample for review and approval.
2.02 STABILIZER BINDER

A. Patented, non-toxic organic binder that is colorless and odorless concentrated powder that binds decomposed granite together to produce a firm surface.

B. Acceptable Manufacturers:
   1. Stabilizer (800) 336-2468; Stabilizer Solutions, Inc.

C. Acceptable Local Supplier:
   1. Gail Materials (909) 279-1095 or approved local equal.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Verify that gradients and elevations of subgrade are correct. Ensure that a minimum of 1 1/2% cross slope will be provided. Contact Owner’s Authorized Representative if this minimum percentage will not be maintained.

B. Verify that subgrade consists of a minimum of 8-inches of compacted soil.

C. Verify that soil cement base course will extend to edge of decomposed granite paving and will achieve a positive outfall for trapped water.

D. Remove loose material from compacted subbase surface immediately before placing decomposed granite screenings.

E. Wet surface of soil cement base course prior to placing decomposed granite screenings.

3.02 BLENDING STABILIZER

A. Blend 14 pounds of Stabilizer powder per ton of decomposed granite screenings. It is critical that Stabilizer be thoroughly and uniformly be mixed throughout decomposed granite screenings.

B. Blending stabilizer shall be incorporated with the DG by use of a pug mill that includes a weight belt feeder to insure the proper ratio of stabilizer to DG. Blending with the use of a bucket loader or belt blending without a weight feeder are not acceptable methods.
3.03 PLACEMENT OF DECOMPOSED GRANITE SCREENINGS

A. Place Stabilized and fiber-added decomposed granite screenings to a depth indicated in Paving Schedule on Drawings.

B. Grade and smooth decomposed granite paving per approved Owner’s Authorized Representative mock-up.

C. Apply water until moisture penetrates to full depth of decomposed granite screenings. It is critical that full section of Stabilized decomposed granite screenings receive water at this time.

D. Upon thorough moisture penetration, compact decomposed granite screenings to within 90% relative compaction by using a vibrating plate tamp or similar compaction equipment.

E. Take care in compacting decomposed granite screenings when adjacent planting and irrigation systems.

F. Allow the finished surface enough time to dry completely before allowing traffic.

3.04 REPAIRS AND PROTECTION

A. Remove and replace decomposed granite paving that is damaged, defective, or does not meet requirements of this Section.

B. Protect decomposed granite paving from damage until Final Payment.

3.05 CLEANUP

A. Upon completion of Work under this Section, remove rubbish, waste and debris resulting from Contractor’s operations. Leave work area in a neat and clean condition.

END OF SECTION
SECTION 02750

ASPHALT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prime coat.
B. Tack coat.
C. Asphalt concrete paving.
D. Asphalt concrete overlay.
E. Speed humps.
F. Asphalt curbs.
G. Pavement grinding.
H. Adjusting manholes, valves, monument covers and other structures to grade.

1.2 RELATED SECTIONS

A. Section 02320, Pavement Subbase and Base Courses.

1.3 RELATED DOCUMENTS

A. Geotechnical Report.
B. ASTM:

C. Caltrans Standard Specifications.
   1. Section 39: Asphalt Concrete.
   2. Section 88: Engineering Fabrics.
   4. Section 93: Liquid Asphalts.
   5. Section 94: Asphaltic Emulsions.

1.4 DEFINITIONS


1.5 QUALITY ASSURANCE

A. Testing Agency: Owner’s Representative will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from specified requirements.

B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

C. Thickness of Asphalt Concrete: In-place compacted thickness of asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by testing agency according to ASTM D 979.
   1. Reference maximum theoretical density will be determined by averaging results from 4 samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to Job-Mix Design.
2. In-place density of compacted pavement may be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
   a. One core sample may be taken for every 1000 sq. yd. or less of installed pavement, but in no case will fewer than 3 cores be taken.
   b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01330.

B. Job-Mix Designs: Certificates signed by manufacturers certifying that each asphalt concrete mix complies with requirements.

C. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

D. Product Data:
   1. Pavement Reinforcing Fabric.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:
   1. Prime Coat: Minimum surface temperature of 60 deg F at application.
   2. Tack Coat: Minimum surface temperature of 60 deg F at application.
   3. Asphalt Concrete: Minimum surface temperature of 50 deg F at application.
   4. Pavement Reinforcing Fabric: Air temperature is 50 deg F and rising and pavement temperature is 40 deg F and rising.

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE

A. Caltrans Standard Specifications Section 39, Type B.

B. Asphalt Materials:


F. Sand: ASTM D 1073, Grade No. 2 or 3.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Notify Owner’s Representative in writing of any unsatisfactory conditions. Do not begin paving until these conditions have been satisfactorily corrected.

3.2 PAVEMENT GRINDING

A. Clean existing paving surface of loose or deleterious material immediately before pavement grinding.

B. Grind conforms as indicated.

3.3 SOIL STERILANT

A. Furnish and apply to areas indicated in accordance with Section 02300.

3.4 SURFACE PREPARATION FOR AGGREGATE BASE MATERIALS

A. General: Immediately before placing asphalt materials remove loose and deleterious material from substrate surfaces and ensure that prepared subgrade is ready to receive paving according to the Caltrans Standard Specification Section 39-4.01.
B. Prime Coat: Apply uniformly over surface of compacted-aggregate base according to the Caltrans Standard Specification Section 39-4.02. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure for 24 hours minimum.
   1. If prime coat is not entirely absorbed within 8 hours after application, spread excess prime coat with hand tools and broadcast sand over surface to blot excess asphalt. Use just enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
   2. Protect primed substrate from damage until ready to receive paving.

C. Tack Coat: Apply uniformly to all vertical surfaces against which asphalt concrete is to be placed, including existing surfaces of previously constructed asphalt or portland cement concrete paving and to surfaces abutting or projecting into new asphalt pavement, according to the Caltrans Standard Specification Section 39-4.02.
   1. Allow tack coat to cure undisturbed before paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 SURFACE PREPARATION FOR PAVEMENT AT ASPHALT CONCRETE OVERLAYS

A. Pavement Irregularities: Level with asphalt concrete, Type B, No. 4 maximum.

B. Pavement Cracks:
   1. Less than ¼-inch wide: Clean of all dirt by compressed air jet, spray and seal with RS-1 asphaltic emulsion.
   2. Wider than ¼-inch: Clean of all dirt by compressed air jet, spray and seal with RS-1 asphaltic emulsion and skin patch.

C. Clean surface of all material, such as leaves, dirt, sand, gravel, water and vegetation prior to applying binder of paving asphalt to existing surface.

3.6 PAVEMENT REINFORCING FABRIC

A. Protect from exposure to ultraviolet rays until placed.

B. Reject rolls with broken or damaged cores, or factory wrinkled fabric that prevents wrinkle-free placement.

C. Place with binder of paving asphalt in accordance with Section 39-4.03 of Caltrans Standard Specifications.
3.7 ASPHALT CONCRETE SPREADING AND COMPACTING EQUIPMENT

A. Spreading Equipment: Caltrans Standard Specification Section 39-5.01.


3.8 ASPHALT CONCRETE PLACEMENT

A. Place, spread and compact asphalt concrete to required grade, cross section, and thickness according to the Caltrans Standard Specification Sections 39-6.01, 39-6.02 and 39-6.03.

B. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.9 JOINTS

A. Construct joints to ensure continuous bond between adjoining paving sections according to the Caltrans Standard Specification Sections 39-6.01 and 39-6.02.
   1. Construct joints free of depressions with same texture and smoothness as other sections of asphalt course.
   2. Clean contact surfaces and apply tack coat.
   3. Offset longitudinal joints in successive courses a minimum of 6 inches.
   4. Offset transverse joints in successive courses a minimum of 24 inches.
   5. Compact joints as soon as asphalt concrete will bear roller weight without excessive displacement.

3.10 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact according to the Caltrans Standard Specification Sections 39-6.01 and 39-6.03.

B. Compaction Requirements: Average Density to be 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

C. Finish Rolling: Finish roll paved surfaces to remove roller marks while asphalt is still warm.
D. **Edge Shaping:** While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.

E. **Repairs:** Remove paved areas that are defective or contaminated with foreign materials and replace with fresh asphalt. Compact by rolling to specified density and surface smoothness.

F. **Protection:** After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.11 ASPHALT CURBS

A. **Construction:** Place over compacted surfaces according to Caltrans Standard Specification Section 39-7.01 as specified for dikes. Apply a light tack coat prior to construction.

B. **Shape:** Place asphalt concrete to curb cross section indicated.

### 3.12 SPEED HUMPS

A. Construct speed humps over compacted pavement surfaces according to Caltrans Standard Specification Section 39-6. Apply a light tack coat prior to construction.

B. Place asphalt concrete by hand using a template/screed designed to result in speed hump cross-section indicated after compaction.

C. Compact speed humps with 8 ton static roller.

### 3.13 ADJUSTING MANHOLES, VALVES, MONUMENT COVERS AND OTHER STRUCTURES TO GRADE

A. Remove pavement, using vertical cuts, as needed to remove frame and provide for concrete collar. Do not damage adjacent pavement.
   1. **Circular Covers:** Cut circle with radius 6 inches larger than cover and concentric with cover.
   2. **Rectangular Covers:** Cut rectangle 6 inches larger than cover on all sides.

B. Install grade rings or blocking as needed to raise cover to finish grade.
C. Pour concrete collar:
   1. Bottom of Collar: Top of existing collar or 6 inches below top of proposed collar, whichever is at a higher elevation.
   2. Top of Collar: 2 inches minimum below finished surface of asphalt concrete pavement. Slope collar away from structure.
   3. Apply tack coat to all exposed surfaces.
   4. Fill excavation with asphalt concrete and, while still hot, compact flush with adjacent surface.

3.14 INSTALLATION TOLERANCES

A. Asphalt Pavement:
   1. Course thickness and surface smoothness within the tolerances specified in Caltrans Standard Specification Sections 39-6.01, 39-6.02 and 39-6.03.
   2. Total Thickness: Not less than indicated.

B. Trench Patch:
   1. Compacted surface: Within 0.01 foot of adjacent pavement.
   2. Do not create ponding.

C. Adjust Covers:
   1. Compacted surface: Up to 0.01 foot higher, and no lower, than adjacent pavement.
   2. Do not create ponding.

END OF SECTION
PART 1 - GENERAL

1.01 GENERAL CONDITIONS

A. Requirements of "General Conditions of the Contract" and of Division 1, "General Requirements", apply to work in this Section with same force and effect as though repeated in full herein.

1.02 SCOPE OF WORK

A. Furnish materials, labor, transportation, services, and equipment necessary to furnish and install concrete pavers as indicated on Drawings and as specified herein.

B. Work included in this Section:
   1. Sand setting bed.
   2. Installation of concrete pavers.

C. Work related in other Sections:
   1. Section 02900 – Landscape Planting.
   2. Section 02810 – Landscape Irrigation.
   4. Section 02970 – Operation and Maintenance of Planting.

1.03 REFERENCES

A. American Society of Testing Materials (ASTM):
   4. C140: Method of Sampling and Testing Concrete Masonry Units.
   5. C936: Specification for Solid Concrete Paving Units.

1.04 QUALITY ASSURANCE
A. Installer of concrete pavers shall be a corporation with at least five years of continuous commercial experience as the same entity doing business in the installation of concrete pavers.

1.05 SUBMITTALS

A. Submit shop or product drawings and product data.

B. Submit five samples of each concrete paver specified.

C. Submit sieve analysis for grading of bedding and joint sand.

D. Submit test results for compliance of concrete pavers to requirements of ASTM C936 from an independent testing laboratory.

1.06 MOCK-UPS

A. Install a 10-foot square mock-up of each pattern specified.

B. Mock-ups will be standard from which future work will be judged.

C. Construct mock-ups on-site in an area where there preservation can be maintained throughout the course of work.

1.07 ENVIRONMENTAL CONDITIONS

A. Do not install sand or pavers during rain.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaging: Pavers shall be packaged on pallets in such a way as to minimize damage during transportation, delivery, storage and handling.

B. Rate of supply: Deliver pavers to the construction site in such quantities and at such times as will assure the continuity of the installation.

C. Storage: Place packaged pavers on firm, level, and smooth surfaces and at least 6 in. above the ground. Place stored pallets so that identification marks are visible.

D. Damaged pavers: No paver, on part thereof, used in the permanent works shall
exhibit obvious signs of damage on the top surface, including but not limited to chipping, cracking and staining. Such damage shall be grounds for rejection.

E. Bedding sand: Deliver and stockpile bedding sand in such a way as to minimize contamination and segregation. Stockpiles are to be located on firm, level, and smooth surfaces that do not channel water into the sand.

F. Jointing sand: Deliver jointing sand in bags and store in such a way as to minimize contamination.

G. Joint sand stabilizer: Deliver and store in strict accordance with the manufacturers instructions and maintain a temperature range of 50 degrees to 105 degrees F.

1.09 COORDINATION

A. Notify General Contractor and other contractors related to installation of Work in ample time, so as to allow sufficient time for those contractors to perform their portion of work.

PART 2 - PRODUCTS

2.01 CONCRETE PAVERS

A. Concrete pavers shall be in accordance with patterns as indicated on Drawings.

B. Supply only concrete pavers that are manufactured and supplied by a member of Concrete Paver Institute.

C. Acceptable Manufacturers:
   1. Acker-Stone – (800) 258-2353

D. Refer to construction schedule on Drawings for concrete paver shape, color and thickness.

E. Concrete used on this project to meet following requirements set forth in ASTM C936, Standard Specification for Concrete Pavers:
   1. Minimum average compression strength: 8,000 psi.

2.02 SAND BEDDING COURSE
A. Clean, non-plastic, free from deleterious or foreign matter, and be natural or manufactured from crushed rock in accordance with ASTM C136.

B. Sand particles to be sharp and conform to grading requirements of ASTM C33 as indicated below:

<table>
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<tr>
<th>Sieve Size</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>No. 4</td>
<td>95 to 100</td>
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<tr>
<td>No. 50</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 100</td>
<td>2 to 10</td>
</tr>
</tbody>
</table>

2.03 CEMENT TREATED BASE

A. General

1. Cement Treated Base (CTB) shall consist of aggregate, cement and water uniformly mixed in a central plant, transported to the project, spread, compacted, shaped, finished and cured in accordance with these specifications. It shall conform to the lines, grades, thicknesses and typical cross-section shown on the plans.

B. Materials

1. Cement shall comply with the latest specifications for Portland cement –

   ASTM C150 (Type I) or Portland-Pozzolan-ASTM C595 (Type IP).
   a. Water shall be free from substances deleterious to the hardening of the Cement Treated Base.
   b. Aggregate may be any granular material or combinations of aggregates that will, when mixed with adequate amounts of cement and water, produce laboratory mix design Unconfined Compression Test strength of 400 psi at 7 days in accordance with the ASTM D-1633 Method “A.” The preceding tests will utilize the Moisture-Density Relation as determined by ASTM D-558: AASHTO T-134. The maximum size of aggregate shall pass a 2-inch sieve.

C. Equipment Cement Treated Base may be constructed with any combination of machines or equipment that will produce the results meeting these specifications.
PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that sub-base is dry and ready to support sand, concrete pavers and anticipated vehicle loads.

B. Verify that gradients and elevations of sub-base are correct.

C. Verify location, type, installation and elevations of edge restraints around perimeter area to be paved.

D. Beginning of concrete paver installation means acceptance of base and edge restraints.

3.02 INSTALLATION OF SAND BEDDING

A. Spread sand evenly over sub-base course and screed to a consistent 1-inch thickness.

B. Do not disturb screeded sand.

C. Place sufficient sand to stay ahead of laid concrete pavers.

D. Lay concrete pavers in patterns as indicated on Drawings. Maintain straight pattern lines, unless otherwise noted on Drawings.

E. Joints between concrete pavers: butt joints.

F. Fill gaps at edges of paved area with cut concrete pavers or edge units.

G. Cut concrete pavers along its edge with a double-bladed splitter or masonry saw.

H. Use a low amplitude, high frequency plate vibrator capable of producing 3,000 to 5,000 lbs. centrifugal compaction force to vibrate concrete pavers into sand bedding course.

I. Vibrate concrete pavers, sweeping dry sand into joints and vibrate until they are fully settled. This will require at least two or three passes with vibrator. Do not vibrate within 3 feet of unrestrained edges of concrete pavers.

J. Sweep off excess sand when Work is complete.
K. Do not allow final surface elevations to deviate more than 3/8-inches under a 10-foot long straight edge.

L. Verify that surface elevations of concrete pavers are at least 1/8 to 1/4-inches above adjacent drainage inlets, paving edge restraints or gutters.

3.03 JOINTING SAND STABILIZER

A. On completion of the entire pavement installation the surface shall be swept so that the sand level is at the bottom of the chamfers.

B. The surface shall be made clean and free from oil, laitance, dust and any loose material prior to the application of joint sand stabilizer. The surface and joint sand should be dry for its full depth prior to commencing work.

C. The joint sand stabilizer sealer shall be applied evenly at the appropriate coverage as follows: Surebond shall be applied from a low pressure regulated backpack sprayer at a coverage rate of 150sqft/gallon. Work the excess material into the joints using a floor squeegee ensuring that all joints are adequately flooded and with the manufacturers recommendations.

D. The treated area shall be protected from rain or moisture and not be trafficked for 24 hours after completing to the stabilizer. Work shall cease if inclement weather (rain or strong wind) will affect the stabilizing operation and shall not recommence until the joint sand has dried sufficiently to allow penetration of the sealant.

3.04 INSTALLATION OF CEMENT TREATED BASE

A. Before other construction operations are begun, the area to be paved shall be graded and shaped as required to receive the Cement Treated Base in conformance with the grades, lines, thicknesses and typical cross-section shown on the plans. Unsuitable subgrade soil or material shall be removed and replaced with suitable soil. The subgrade shall be firm and able to support without displacement of the construction equipment and the compaction hereafter specified. Soft or Yielding subgrade shall be corrected and made stable before construction proceeds.

B. Place the geotextile sheeting over prepared subgrade, overlapping ends and edges at least 12 in.

C. The aggregate, cement and water shall be mixed in a pug mill. The plant shall be equipped with feeding and metering devices that will add the aggregate, cement and
water into the mixer in the specified quantities to produce a mixture that will meet or exceed the mix design criteria as stated above. The aggregate and the cement shall be mixed sufficiently to prevent cement balls from forming when the mix water is added. The mixing time shall be sufficient to assure an intimate, uniform mixture of aggregate, cement and water. The percentage of moisture in the aggregate, at the time of cement application shall be the amount that assures a uniform and intimate mixture of aggregate and cement during mixing operations. It shall not exceed the specified moisture content required for adequate compaction. The mixture shall be hauled to the paving areas in trucks having beds cleaned of deleterious material.

D. The mixture shall be placed on a moistened subgrade in a uniform layer by any approved method of spreading that will deposit the required quantity per lineal foot, without segregation, to produce a uniformly compacted base conforming to the grade and cross-section. Not more than 30 minutes shall elapse between placement of CTB in adjacent lanes at any location except at longitudinal and transverse construction joints. No CTB mixture shall be placed when the subgrade is frozen or when the air temperature is less than 40°F in the shade. Compaction shall start as soon as possible after spreading. The elapsed time between the addition of water to the CTB mixture and the start of compaction shall not exceed 60 minutes under normal conditions. Laboratory tests may be required to verify changes in compaction time limits. At the start of compaction, the percentage of moisture in the mixture shall not be more than one percentage point below or two percentage points above the specified optimum moisture content, and shall be less than that compaction and finishing. The specified optimum moisture content and density shall be determined in the field by a Moisture-Density Test. AASHTO T 134 or ASTM D 556, on representative samples of Cement Treated Base moisture obtained from the area prior to compaction. Prior to compaction, the mixture shall then be compacted uniformly to the specified density. During compaction operations, initial shaping may be required to obtain uniform compaction and required grade and cross-section.

E. When initial compaction is completed, the surface of the Cement Treated Base shall be shaped to the required lines, grades and cross-section. The moisture content of the surface material shall be maintained at not less than its specified optimum moisture content during finishing operations. If any reshaping of the surface is necessary, it shall be lightly scarified to remove any compaction planes, scales or smooth surfaces left by equipment. Final compaction shall then be continued until uniform and adequate density is obtained. The CTB shall be uniformly compacted to the minimum of 95% of maximum density. Compaction and finishing shall be done in such a manner as to produce, in not longer than two hours, a smooth, dense surface free of compaction planes, cracks, ridges, or loose material.

F. Finished portions of Cement Treated Base that are traveled on by equipment used in
construction an adjoining section shall be protected in such a manner as to prevent equipment from marring or damaging completed work. Cement Treated Base shall be protected against freezing for seven days after its construction and until it has hardened. Curing shall be performed in accordance with manufacturer’s recommendations. Construction Joints: At the end of each day’s construction a transverse construction joint shall be formed by cutting back in to the completed work to form a full depth vertical face free of loose or shattered material. The section may be opened to all traffic provided that the Cement Treated Base has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

G. The contractor shall be required within the limits of his contract to maintain the Cement Treated Base in good condition until all the work has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Faulty work shall be corrected. Any low areas shall be remedied by replacing the material for the full depth of treatment rather than by adding a thin layer of Cement Treated Base to the completed work.

3.05 FIELD QUALITY CONTROL

A. After removal of excess sand, re-check surface elevations for conformance to Drawings. Make adjustments as necessary.

3.06 CLEAN UP

A. Upon completion of Work, remove rubbish, waste and debris resulting from operations off-site. Remove equipment and implements of service, and leave entire work area in a neat, clean, and Owner-accepted condition.

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A. Removal of existing traffic stripes and pavement markers.

B. Removal of existing signs.

C. Cleaning and sweeping of streets before application of traffic stripes and pavement markings.

D. Materials and application for traffic stripes and pavement markings.

E. Materials and application for pavement markers.

F. Traffic control signs and street name signs.

G. Object markers.

1.2  RELATED SECTIONS

A. Section 02750, Asphalt Concrete Pavement.

1.3  RELATED DOCUMENTS

A. Caltrans Standard Specifications:
   1. Section 56, Signs.
   2. Section 81, Monuments.
   3. Section 82, Markers and Delineators.
   4. Section 84, Traffic Stripes and Pavement Markings.
   5. Section 85, Pavement Markers.

B. Caltrans Standard Plans:
7. Plan A73B: Markers.
8. Plan RS1: Roadside Sign, Typical Installation Details No. 1.

C. Federal Highway Administration Manual on Uniform Traffic Control Devices (MUTCD) and State of California MUTCD Supplement, edition in effect at time of date on plans.

D. The regulations, standards, and tests of the State of California Department of Transportation Materials and Research Division, edition in effect at time of date on plans.

1.4 QUALITY ASSURANCE

A. Deliver certificates showing conformance with this specification to the Owner’s Representative with each shipment of materials and equipment to the Project site.

1.5 PROJECT CONDITIONS

A. Do not apply traffic striping or pavement markings to the pavement until after approval to proceed has been given by the Owners Representative.

B. Thoroughly cure new asphalt concrete and portland cement concrete before application of stripes, markings or markers.

PART 2 PRODUCTS

2.1 THERMOPLASTIC STRIPES AND MARKING

A. To be used only where noted specifically on plans.

B. Conform thermoplastic striping and marking materials to Section 84-2.02 of Caltrans Standard Specifications, unless noted otherwise herein or on the Plans.

2.2 PAINTED STRIPES AND MARKINGS

A. Conform painted striping and marking materials to Section 84-3.02 of Caltrans Standard, Specifications, unless noted otherwise herein or on the Plans.
2.3 PAVEMENT MARKERS

A. Types: Section 85-1.02 of Caltrans Standard Specifications and as indicated.

B. Sampling, Tolerances and Packaging: Section 85-1.03 of Caltrans Standard Specifications.

C. Material
1. Non-reflective: Section 85-1.04 of Caltrans Standard Specifications. Type as indicated.
2. Retroreflective: Section 85-1.05 of Caltrans Standard Specifications. Type as indicated.

2.4 TRAFFIC CONTROL SIGNS

A. General: Section 56-2 of the Caltrans Standard Specifications.

B. Sign Panels: Conform type (regulatory or warning), size, shape and pattern to the MUTCD and State of California MUTCD Supplement, edition in effect at the date of the Plans. Sign faces to be of reflectorized porcelain enamel.

C. Posts:
   1. Metal: Two (2) inch inside diameter steel pipe. Conform to Section 56-2.02A of Caltrans Standard Specifications, unless otherwise specified.

D. Mounting Hardware: Section 56-2.02D of Caltrans Standard Specifications, unless otherwise specified.

E. Post Foundations: Portland cement concrete conforming to Section 03301.

2.5 STREET NAME OR DIRECTIONAL SIGNS

A. Conform to manufacturer, style, size, and shape shown on the Plans.

B. Posts: Two (2) inch inside diameter steel pipe unless noted otherwise on the Plans. Conform to Section 56-2.02A of Caltrans Standard Specifications.

2.6 REFLECTORIZED OBJECT MARKERS

A. Reflectorized Metal Object Markers: Conform to the applicable requirements of Section 82 of Caltrans Standard Specifications for target plates and reflectors, and Caltrans Standard Plan A73A for type L-1 or L-2 object markers. Type as shown on the Plans.

B. Posts: Metal posts conforming to the applicable requirements of Section 82-1.02B of Caltrans Standard Specifications and Caltrans Standard Plan A73B.

C. Mounting Hardware: Conform to the applicable requirements of Section 82-1.02G of Caltrans Standard Specifications.

PART 3 EXECUTION

3.1 REMOVAL OF TRAFFIC STRIPES, PAVEMENT MARKINGS AND PAVEMENT MARKERS

A. Where blast cleaning is used for the removal of painted traffic stripes and pavement markings, or for removal of objectionable material, remove the residue, including dust and water, immediately after contact with the surface being treated. Remove by a vacuum attachment operating concurrently with the blast cleaning operation.

B. Where grinding is used for the removal of thermoplastic traffic stripes and pavement markings; remove the residue by means of a vacuum attachment to the grinding machine. Do not allow the residue to flow across or be left on, the pavement.

C. Where markings are to be removed by blast cleaning or by grinding, the removed area shall be approximately rectangular so that no imprint of the removed marking remains on the pavement.

D. Contractor will be responsible for repairing any damage to the pavement during removal of pavement markers. Damage to the pavement, resulting from removal of pavement markers, shall be considered as any depression more than 1/4-inch deep.

3.2 TEMPORARY PAVEMENT MARKERS

A. If permanent pavement markers cannot be installed immediately, and the street or road is to be placed in service, install short term, temporary pavement markers on the new pavement prior to opening the street or road to traffic.
B. Place markers at a maximum of 24 feet on centers, or as required by the governmental agency having jurisdiction, in the appropriate colors to delineate centerlines and travel lanes on multi-lane roadways.

3.3 THERMOPLASTIC TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. Apply in conformance with the manufacturer's instructions and the applicable requirements of Section 84-2.04 of Caltrans Standard Specifications and Caltrans Standard Plans A20A through A20D, and A24A through A24E.

3.4 PAINTED TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. Apply in conformance with the manufacturer's instructions and the applicable requirements of Section 84-3.03, 3.04 and 3.05 of Caltrans Standard Specifications and Caltrans Standard Plans A20A through A20D, and A24A through A24E.

3.5 PAVEMENT MARKERS

A. Place in conformance with the requirements of Section 85-1.06 of the Caltrans Standard Specifications.

B. Pavement recesses are not required. Markers shall be installed accurately to the line established by the Engineer. No markers shall be installed until the surface has been approved by the Owner’s Representative.

3.6 TRAFFIC CONTROL SIGNS

A. Install in conformance with Sections 56-2.03 and 2.04 of Caltrans Standard Specifications, Caltrans Standard Plan RS1, the applicable requirements of the State of California Department of Transportation Maintenance Manual and the details shown on the Plans. The horizontal locations shown on Caltrans Standard Plan RS1 shall not be applicable, the horizontal location shall be as shown on the Plans.

B. Portland cement concrete for post foundations shall be of the configuration shown on the Plans.

C. After erection, damage to traffic sign faces shall be touched up or the sign replaced.

3.7 STREET NAME SIGNS

A. Install in accordance with the manufacturer’s instructions and as shown on the Plans.
B. Horizontal location shall be as shown on the Plans.

C. Portland cement concrete for post foundations shall be of the configuration shown on the Plans.

3.8 REFLECTORIZED OBJECT MARKERS.

A. Install in conformance with the requirements of Section 82-1.03 of Caltrans Standard Specifications, except that the metal marker posts shall not be driven in place without prior approval of the Owner’s Representative.

B. Install at locations shown on the Plans.

3.9 PROTECTION

A. Protect the newly installed and traffic stripes and pavement markings from damage until the material has cured.

B. Replace any traffic stripes or pavement markings or markers broken, misaligned or otherwise disturbed prior to opening roadway to traffic.

3.6 RESTORATION OF EXISTING IMPROVEMENTS

A. Existing signs, striping or other markings removed or damaged due to the installation of new facilities shall be replaced in kind.

B. Existing landscaping or planting removed, damaged or disturbed due to the installation of traffic control signs or street name signs shall be replaced in kind.

END OF SECTION
PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The requirements of the "General Conditions of the Contract" and of Division 1, "General Requirements", shall apply to all work in this Section with the same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

A. Furnish all materials, labor, transportation, services, and equipment necessary to install landscape irrigation as shown on the Drawings and as specified herein.

1. Work included in this Section:
   a. Layout.
   b. Trenching.
   c. Backfilling.
   d. Assemblage.
   e. Wiring.
   f. System Flushing.
   g. Sprinkler Head Installation.
   h. Valve Installation.
   i. System Testing and Adjustment.
   j. Maintenance.

2. Work related in other Sections:
   a. Section 02900 - Landscape Planting.
   b. Section 02810-A - Landscape Irrigation - Dripline

1.3 DEFINITIONS

A. The Owner's Authorized Representative in this Section will refer to the BEK/LLC or the Landscape Architect.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. All local, municipal and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of this Specification, and its provisions shall be carried out by the Contractor. Anything
contained in this Specification shall not be construed to conflict with any of the above rules and regulations or requirements of the same. However, when the Drawings and Specifications call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of the Drawings and Specifications shall take precedence.

1.5 QUALITY CONTROL

A. Manufacturer's Directions
   1. The Manufacturer's directions and drawings shall be followed in all cases where the manufacturers of articles used in this Specification, furnish directions covering points not shown in the Drawings and Specifications.

B. Permits, Fees, Bonds and Inspections
   1. The Contractor shall pay for any and all permits, fees, bonds and inspections necessary to perform and complete his portion of the Work.

C. Explanation of the Drawings
   1. Due to the scale of the Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. The Drawings are diagrammatic only and are indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.
   2. All work called for on the Drawings by notes or details shall be furnished and installed whether or not specifically mentioned in this Specification.
   3. The Contractor shall not willfully install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Owner's Authorized Representative. In the event this notification is not performed, the Contractor shall assume full responsibility for any revisions necessary.

1.6 SUBMITTALS

A. Materials List
   1. The Contractor shall furnish the articles, equipment, materials, or processes specified by name in the Drawings and Specifications. No substitution will be allowed without prior written approval by the Owner's Authorized
Complete material list shall be submitted prior to performing any work. Material list shall include the manufacturer, model number and description of all materials and equipment to be used. Although manufacturer and other information may be different, the following is a guide to proper submittal format:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Model No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Backflow Preventer</td>
<td>Febco</td>
<td>825Y</td>
</tr>
<tr>
<td>2.</td>
<td>Gate Valve</td>
<td>HAmmond</td>
<td>850B</td>
</tr>
</tbody>
</table>

The irrigation submittal list must be specific and complete. All items must be listed and should include solvent/primer, wire, wire connectors, valve boxes, etc. No copies of manufacturer's literature (catalog cuts) are required as submittal information.

3. The Contractor may submit substitutions for equipment and materials listed on the Drawings by following procedures as outlined in Section 1.8 of this Specification.

4. Equipment or materials installed or furnished without prior approval of the Owner's Authorized Representative may be rejected and the Contractor required to remove such materials from the site at no cost to the Owner.

5. Approval of any item, alternate or substitute indicates only that the product or products apparently meet the requirements of the Drawings and Specifications on the basis of the information or samples submitted.

6. Manufacturer's warranties shall not relieve the Contractor of his liability under the Guarantee. Such warranties shall only supplement the Guarantee.

B. Record Drawings or "As-Builts"

1. The Contractor shall provide and keep up to date at all times, a complete record set "As-builts" of blue line ozalid prints which shall be corrected daily and show every change from the original Drawings and Specifications and the exact installed locations, sizes, and kinds of equipment. Prints for this purposes may be obtained from the Owner's Authorized Representative at the Contractor's cost. "As-builts" shall be kept on the site and shall be used only as a record set.

2. "As-builts" shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed. "As-builts" shall be available at all times for observation and shall be kept in a location easily accessible to the Owner's Authorized Representative. Should the "As-built" progress sheets not be available for review or not current at the time of any
site visit by the Owner's Authorized Representative, it will be assumed no work has been completed and the Contractor will be assessed the cost of that site visit at the current billing rate of the Owner's Authorized Representative. No other site observations shall take place without prior payment of this assessment.

3. The Contractor shall make neat and legible notations on the "As-built" progress sheets daily as the work proceeds, showing the work as actually installed. For example, should a piece of equipment be installed in a location that does not match the Drawings, the Contractor must indicate that equipment has been relocated in a graphic manner so as to match the original symbols as indicated in the irrigation legend. The relocated equipment and dimensions will then be transferred to the original "As-builts" at the proper time.

4. Before the date of the Final Walk-through, the Contractor shall transfer all information from the "as-built" prints to sepia mylar plans procured from the Owner's Authorized Representative at the Contractor's cost. All drafting shall be done with waterproof technical pen ink and applied to the sepia mylar by technical drafting pens made expressly for use on mylar surfaces. Dimensions shall be made on the sepia mylar so as to be easily readable even on the final irrigation controller chart. The original sepia mylar "As-builts" shall be submitted to the Owner's Authorized Representative for approval prior to the making of the irrigation controller charts.

5. The Contractor shall dimension from two (2) permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following items:
   a. Connection to existing water lines.
   b. Connection to existing electrical power.
   c. Gate valves.
   d. Routing of sprinkler pressure lines.
   e. Sprinkler control valves.
   f. Routing of control wiring.
   g. Quick coupling valves.
   h. Backflow preventer.
   i. Other related equipment.

6. On or before the date of the Final Walk-through, the Contractor shall deliver the corrected and completed sepia mylar "As-builts" to the Owner's Authorized Representative. Delivery of the sepia "As-builts" will not relieve the Contractor of the responsibility of furnishing required information that may be omitted from the "As-builts".

C. Irrigation Controller Charts

1. "As-built" drawings shall be approved by the Owner's Authorized Representative before irrigation controller charts are prepared.
2. Provide one irrigation controller chart for each irrigation controller supplied.
3. Each irrigation controller chart shall show the area controlled by that irrigation controller and shall be the maximum size of which the irrigation controller door will allow.
4. The irrigation controller chart is to be a reduced drawing of the actual installed irrigation system. In the event that the irrigation controller chart is not legible when the chart is reduced, it may be enlarged to a size that will be readable when reduced.
5. The irrigation controller chart shall be a 11” x 17” Xerox bond reduction with each valve station represented by a different color.
6. When completed, hermetically seal the irrigation controller chart between two pieces of 3 mil plastic with a 1/8” edge overlap.
7. Irrigation controller charts shall be completed and approved by the Owner's Authorized Representative prior to the Final Walk-through.

D. Operation and Maintenance Manuals
1. Prepare and deliver to the Owner's Authorized Representative within 10 calendar days prior to completion of irrigation installation, two (2) - 3 ring hard cover binders each containing the following information:
   a. Index sheets stating the Contractor's address and telephone number and a list of equipment with the name and addresses of local manufacturer's representatives.
   b. Catalog and part sheets on every material and equipment installed under this Contract.
   c. Guarantee statement.
   d. Complete operating and maintenance instruction on all major equipment.
2. In addition to the above mentioned maintenance manual, provide the Owner with on-site instructions for major equipment and show evidence in writing to the Owner's Authorized Representative at the conclusion of the Project that this service was rendered.

E. Equipment to be Furnished
1. Supply as a part of this Contract the following tools:
   a. Two (2) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on the Project.
   b. Two (2) five-foot valve keys for operation of gate valves.
   c. Two (2) keys for each automatic controller and irrigation controller enclosure.
   d. One (1) quick coupler key and matching hose swivel for every five (5), or fraction thereof, of each type of quick coupling valve installed.
2. The above mentioned equipment shall be turned over to the Owner at the conclusion of the Project. Before the Final Walk-through shall be

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performed, evidence that the Owner has received this material must be shown to the Owner's Authorized Representative.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handling of PVC Pipe and Fittings
   1. The Contractor is cautioned to exercise care in handling, loading, unloading, and storing of PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping at no cost to the Owner.

1.8 SUBSTITUTIONS

A. If the Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the Drawings and Specifications, he may do so by providing the following information to the Owner's Authorized Representative for approval:
   1. Provide a statement indicating the reason for making the substitution. Use a separate sheet of paper for each item to be substituted.
   2. Provide descriptive catalog literature, performance charts and flow charts for each item to be substituted.
   3. Provide the amount of cost savings if the substituted item is approved.

B. The Owner's Authorized Representative shall have the sole responsibility in accepting or rejecting any substituted item as an approved equal to those equipment and materials listed on the Drawings and Specifications.

1.9 PRIOR TO START OF THE LANDSCAPE MAINTENANCE PERIOD

A. The Contractor shall submit proof of warranty to the Owner's Authorized Representative prior to the start of the landscape maintenance period. All computerized irrigation control system materials except interconnect conductors shall have a five-year warranty. It is the Contractor's responsibility to obtain the necessary warranty inspections from the equipment supplier. No installations will be accepted without proof of warranty.

1.10 GUARANTEE

A. The Guarantee for the irrigation system shall be made in accordance with the attached form.

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B. A copy of the Guarantee form shall be included in the Operations and Maintenance Manual.

C. The Guarantee form shall be re-typed onto the Contractor's letterhead and contain the following information:

D. We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the Drawings and Specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defects in material or workmanship which may develop during the period of one year from date of final acceptance and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT:

LOCATION:

SIGNED:

ADDRESS:

PHONE:

DATE OF ACCEPTANCE:

1.12 RULES AND REGULATIONS

A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.

1.13 PROTECTION OF WORK AND MATERIALS

A. The Contractor shall protect his work and work of others for the duration of the Contract. He shall protect pipes and fittings from direct sunlight, and avoid undue
bending and any concentrated external loading. Pipe or fittings that have been damaged shall not be used.

B. The Contractor shall exercise extreme care in excavating and working near existing utilities. Damage to utilities which are caused by contractor's operation shall be the Contractor's responsibility.

C. The Contractor shall take necessary precautions to protect site conditions and plant material that is to remain. Should damage to incurred, Contractor shall repair damage to its original condition or furnish and install equal replacements.

D. All existing irrigation systems shall be kept in operation at all times. If the existing system is damaged by Contractor, he shall be responsible for immediate repair of such damage. After each repair, all heads of the repaired system shall be removed so that the lines can be cleared of all dirt and foreign matter.

1.14 CORRECTION OF WORK

A. Any and all discrepancies of unsatisfactory work shall be corrected by the Contractor at no additional expense to the Owner. The correction of work shall be finished with a reasonable period mutually agreed upon between the Owner and Contractor prior to acceptance of the improvements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Use only new materials of brands and types noted on the Drawings or Specifications.

2.2 PVC PRESSURE MAIN LINE PIPE AND FITTINGS

A. Pressure main line piping for sizes 2" and larger, shall be PVC Class 315 and purple indicating reclaimed.

B. Class 315 pipe shall be made from an NSF approved Type I, Grade I, PVC compound conforming to ASTM compound specification D1784. All pipe must meet requirements as set forth in ASTM D2241 (Solvent-weld Class Pipe), with an appropriate standard dimension (S.D.R.).

C. Pressure main line piping for sizes 1-1/2" and smaller shall be PVC Schedule 40 with solvent welded joints and purple indicating reclaimed.
D. Schedule 40 pipe shall be made from NSF approved Type I, Grade I PVC compound conforming to ASTM compound specification D1784. All pipe must meet requirements as set forth in ASTM D1785 (Solvent-weld Schedule Pipe).

E. PVC solvent-weld fittings shall be Schedule 40, 1-2, II-I NSF approved conforming to ASTM test procedure D2466.

F. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer.

G. All PVC pipe must bear the following markings:
   1. Manufacturer's name.
   2. Nominal pipe size.
   3. Schedule or class.
   4. Pressure rating in PSI.
   5. NSF (National Sanitation Foundation) approval.
   6. Date of extrusion.

H. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable IPS schedule and NSF seal of approval.

2.3 PVC NON-PRESSURE LATERAL LINE PIPING

A. Non-pressure buried lateral line piping shall be PVC Schedule 40 with solvent-welded joints.

B. Non-pressure lateral line piping installed under paved areas shall be installed in a PVC Schedule 40 sleeve and purple indicating reclaimed.

C. Pipe shall be made from NSF approved, Type I, Grade II PVC compound conforming to ASTM compound specification D1784. All pipe must meet requirements set forth in ASTM D2241 (Solvent-weld Class Pipe) with an appropriate standard dimension ratio.

D. Except as noted in paragraphs A, B, C and D of Section 2.2, all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure main line pipe and fittings as set forth in this Specification.

2.4 BRASS PIPE AND FITTINGS

A. Where indicated on the Drawings, use red brass screwed pipe conforming to Federal Specification #WW-P-351.
2.5 GALVANIZED PIPE FITTINGS

A. Where indicated on the Drawings, use galvanized steel pipe ASA Schedule 40 mild steel screwed pipe.

B. Fittings shall be medium galvanized screwed beaded malleable iron, or Class 150 flanged steel with Corten bolts where required. Galvanized couplings may be merchant coupling.

C. All galvanized pipe and fittings installed below grade shall be painted with two (2) coats of Koppers #50 bitumastic or approved equal. Or cover pipe with 2 layers of plastic, self-adhesive, pipe wrap, 2 mils thick, as manufactured by 3M Company or approved equal.

D. Use non-hardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on all metal threaded connections.

2.6 BALL VALVES

A. Ball valves 3” and smaller shall be 125 lb. SWP bronze ball gate valve with blow-out proof and full port.

B. Ball valves 3” and smaller shall have threaded ends and shall be equipped with a bronze handle.

C. Ball valves 3” and smaller shall be similar to those manufactured by Hammond or approved equal.

D. All ball valves shall be installed per irrigation installation details.

2.7 QUICK COUPLING VALVES

A. Quick coupling valves shall have a brass two-piece body designed for a working pressure of 150 PSI, operable with quick coupler. Key size and type shall be as indicated on the Drawings.

2.8 BACKFLOW PREVENTION UNITS

A. If required, Backflow prevention units shall be of size and type indicated on the Drawings. Install backflow prevention units in accordance with the Drawings.
B. Wye strainers at backflow prevention units shall have a bronzed screwed body with 60 mesh stainless steel screen and shall be similar to the Bailey #100B or approved equal.

C. All pressure mainline piping between the point of connection and the backflow preventer shall be installed as required by local code. The Contractor shall verify with the local governing body as to material type and installation procedures prior to start of construction. Submit shop drawing for approval.

2.9 CHECK VALVES

A. Swing check valves 2" and smaller shall be 200 pound WOG bronze construction with replaceable composition, neoprene or rubber disc and shall meet or exceed Federal Specification WW-V-51D, Class A, Type IV.

B. Check valves shall be of heavy duty virgin PVC construction with FIP threaded inlets and outlets. Internal parts shall be stainless steel and neoprene. Check valves shall be field adjustable against draw-out from 5 to 40 feet of head. Check valves shall be similar to the King Bros. Industries "CV" series, or approved equal.

2.10 CONTROL WIRE

A. Connections between the automatic controllers and the electric control valves shall be made with direct burial copper wire AWG-U.F. 600 volt. Pilot wires shall be a different color wire for each automatic controller. Common wires shall be #12 gauge and the color white with a different color stripe for each automatic controller. Install wires in accordance with valve manufacturer's specifications and wire charts. In no case shall wire size be less than #14 gauge. Wire color shall be continuous over its entire length.

B. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible.

C. Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of 10 feet.

D. An expansion curl shall be provided within three (3) feet of each wire connection. Expansion curl shall be of sufficient length at each splice connection at each electric control, so that in case of repair, the valve bonnet may be brought to the surface without disconnecting the control wires. Control wires shall be laid loosely in the trench without stress or stretching of the control wire conductors.
E. All splices shall be made with either Scotch-Lok #3576 Connector Sealing Packs or Rain Bird Snap-Tite wire connector, or approved equal. Use one splice per connector sealing pack.

F. Field wire splices between the automatic controller and the electrical control valves shall not be allowed without prior approval of the Owner's Authorized Representative.

G. When control wiring is trenched separately from mainline trenches a continuous warning tape shall be installed with the wiring. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored yellow, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

H. Provide a 36-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop.

I. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted. Install one common wire for each controller. Multiple controllers with one common wire will not be permitted.

2.11 AUTOMATIC IRRIGATION CONTROLLERS

A. Automatic irrigation controllers shall be of the size and type as that indicated on the Drawings.

B. Final location of automatic irrigation controllers shall be approved by the Owner's Authorized Representative.

C. Unless otherwise noted on the Drawings, the 120 volt electrical power to the automatic irrigation controller shall be furnished by others. The final electrical hook-up shall be the responsibility of the Contractor.

D. The automatic irrigation controller shall be included as a part of the Irrigation Controller Enclosure Assembly.

2.12 ELECTRICAL CONTROL VALVES

A. All electric control valves shall be the same manufacturer as the automatic controllers unless noted otherwise on the Drawings.
B. All electric control valves shall have a manual flow adjustment.
C. Provide and install one (1) control valve box for each electric control valve.

2.13 VALVE BOXES

A. Use a 10" diameter x 10-1/4" round valve box for gate valves, control wire splices and quick coupling valves as manufactured by Carson-Brooks Plastics, model #910-13B with green bolt-down cover or approved equal. Extension sleeves shall be 6" minimum PVC piping material or approved equal and purple in color indicating reclaimed.

B. Use a 11 3/4" wide x 17" long x 12" deep rectangular valve box for electrical control valves, master valves, and control wire pull boxes, as manufactured by Carson-Brooks Plastics, model #1419-12-3B with a green bolt-down cover or approved equal.

C. Valve boxes shall be a minimum of one (1) foot apart when arranged in a group or side by side, or unless noted otherwise in the Drawings.

2.14 SPRINKLER HEADS

A. All sprinkler heads shall be of the same size, type, and deliver the same rate of precipitation with the diameter (or radius) of throw, pressure, and discharge as shown on the Drawings and in this Specification.

B. Spray heads shall have a screw adjustment.

C. Riser units shall be fabricated in accordance with the Drawings.

D. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.

E. All sprinkler heads of the same type shall be from the same manufacturer.

2.15 IDENTIFICATION TAGS

A. Identification tags for electrical control valves, and other equipment assemblies as designated on Drawings, shall be manufactured from Polyurethane Behr Desopan. Use Christy's standard tag hot stamped with black letters on yellow background. The tags shall be numbered to match station identification as indicated on Drawings. Provide one (1) tag for each electric control valve.
B. Special order tags from T. Christy Enterprises, (714)771-4142 or approved equal.

2.16 IRRIGATION CONTROLLER ENCLOSURE ASSEMBLY

A. The irrigation controller enclosure assembly shall consist of a "Strong Box" housing or approved equal, stainless steel back board, controller, terminal strip, and a 120 volt outlet. Use "Strong Box" Model CA-10 series for one (1) irrigation controller. Use "Strong Box" Model CA-20 series for two (2) irrigation controllers installed at the same location.

B. The stainless steel back board shall be bolted to the housing to provide a base for mounting the irrigation controller and terminal strip.

C. The irrigation controller enclosure assembly shall be equipped with a 120 volt duplex box with an on/off switch, and 120 volt receptacle. Metal conduit shall run from the 120 volt supply to the irrigation controller housing. All power within the housing shall be properly phased.

D. The irrigation controller enclosure assembly shall be equipped with a pre-wired terminal strip clearly indicating the proper points of connection of all appropriate wiring, i.e. station valves, master valve, common and central control.

E. The irrigation controller enclosure assembly shall be manufactured by United Green Tech, (925) 451-1610 and distributed by John Deere (760-784-1111 or approved equal.

2.17 SLEEVING

A. Install separate sleeve beneath paved areas to route each run of irrigation pipe or wiring bundle.

B. Sleevng material beneath pedestrian pavements - PVC Schedule 40 pipe with solvent welded joints.

C. Sleevng beneath streets and drives - PVC Schedule 40 pipe with solvent welded joints.

D. Sleevng diameter - equal to twice that of the pipe or wiring bundle. Minimum sleevng diameter shall be 2 inches.

E. Marking stakes - 2" x 2" x 24" wood stakes.
2.18 OTHER COMPONENTS

A. Tools and Spare Parts
   1. Provide operating keys, servicing tools, test equipment, other items, and spare parts as indicated on section 1.6 of this Specification.

B. Other Materials
   1. Provide other materials or equipment not indicated on the Drawings or referenced in this Specification, as necessary, to complete the installation of the irrigation system.

PART 3 - EXECUTION

3.1 GENERAL

A. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions and receive the Owner's Authorized Representative's approval prior to proceeding with any work under this Specification. Contractor shall locate with 2\" x 2\" wood stakes with identifying markings for all proposed locations of electrical control valve boxes, gate valve boxes and quick coupler boxes for approval by the Owner's Authorized Representative. After locating all these items contact the Owner's Authorized Representative for review and approval. Minor adjustments to the stake locations may be requested of the Contractor by the Owner's Authorized Representative at that time.

B. Exercise extreme care in excavating and working near existing utilities. The Contractor shall be responsible for damages to these utilities which are caused by his operations. Check existing utility drawings for existing utility locations.

C. Coordinate installation of sprinkler irrigation materials including pipe, so that there shall be no interference with utilities, construction elements, or the planting of trees, shrubs, and ground covers.

D. The Contractor shall carefully check all finish grades to satisfy himself that he may safely proceed before starting work on the irrigation system.

E. Report irregularities to Owner's Authorized Representative prior to beginning work. Beginning of work implies acceptance of existing conditions.

3.2 SITE PREPARATION
A. Physical Layout
   1. Prior to installation, the Contractor shall stake out all pressure and non-pressure supply lines and the location of all sprinkler heads.
   2. All layout shall be approved by the Owner's Authorized Representative prior to installation.

B. Water Supply Point-of-Connections
   1. Water supply points of connection are as indicated on the Drawings. The Contractor shall be responsible for minor changes caused by actual site conditions.
   2. The sprinkler irrigation system shall be connected to water supply points of connection as indicated on the Drawings.

C. Electrical Supply Point-of-Connections
   1. Electrical supply point-of-connections for the automatic irrigation controllers are as indicated on the Drawings. The Contractor shall be responsible for minor changes caused by actual site conditions.
   2. Connections shall be made at approximate locations as indicated on the Drawings. The Contractor shall be responsible for minor changes caused by actual site conditions.

3.3 INSTALLATION

A. Trenching
   1. Dig trenches straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow the layout as indicated on the Drawings.
   2. Provide a minimum soil cover of 18 inches for all pressure supply lines.
   3. Provide a minimum soil cover of 12 inches for all non-pressure lines.
   4. Provide a minimum soil cover of 18 inches for all control wire.
   5. Where piping is indicated under paved areas, but running parallel and adjacent to planting areas, install the piping in the planted areas. Irrigation head spacing as indicated on the Drawings shall not be exceeded.

B. Backfilling
   1. The trenches shall not be backfilled until all required tests are performed. Trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, or other approved materials, free from large clods of earth or stones. Backfill shall be mechanically compacted landscaped areas to a dry density equal to adjacent undisturbed soil in planting areas. Backfill shall conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.
   2. A fine granular material backfill shall be initially placed over all lines. No
foreign matter larger than one-half inch in size will be permitted in the initial backfill.

3. Flooding of trenches will be permitted only with the approval of the Owner's Authorized Representative.

4. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, planting, or other construction elements are necessary, the Contractor shall make all required adjustments without cost to the Owner.

C. Trenching and Backfilling Under Paving

1. Trenches located under areas where asphaltic concrete or concrete paving occur, shall be backfilled with sand (a layer six (6) inches below the pipe and three (3) inches above the pipe) and compacted in layers to 95% compaction, using manual or mechanical tamping devices. Trenches for piping shall be compacted to equal the compaction of the existing adjacent undisturbed soil and shall be left in a firm unyielding condition. All trenches shall be left flush with adjoining finish grade. The Contractor shall set in place, cap and pressure test all piping under paving prior to the paving work.

2. Generally piping under existing walks is done by jacking, boring or hydraulic driving, but where any cutting or breaking of concrete is necessary, it shall be done and replaced by the Contractor at no cost to the Owner. Permission to cut or break concrete shall be obtained from the Owner's Authorized Representative. No hydraulic driving will be permitted under concrete paving.

3. Provide a minimum soil cover of 18 inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete paving.

D. Assemblies

1. Routing of irrigation lines as indicated on the Drawings is diagrammatic only. Install lines and various assemblies in such a manner as to conform with the Drawings.

2. Install no multiple assemblies in plastic lines. Provide each assembly with its own outlet.

3. Install all assemblies specified herein in accordance with their respective details. In absence of Drawings or Specifications pertaining to specific items required to complete this work, perform such work in accordance with best standard practice with prior approval of the Owner's Authorized Representative.

4. PVC pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer.

5. On PVC to metal connections work the metal connections first. Teflon tape or approved equal, shall be used on all threaded PVC to PVC and threaded
PVC to metal joints. Apply a light wrench pressure only. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be solvent welded.

E. Assembling Pipe and Fittings:
1. Inspect all pipe and fittings before installation.
3. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
4. Install pipe with all markings up for visual inspection and verification.
5. All lines shall have a minimum clearance of six (6) inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.
6. Maintain 10 foot minimum horizontal separation from all potable water piping. Where reclaimed and potable water pressure main line piping cross, the reclaimed water piping shall be installed below the potable water piping on a PVC Class 200 pipe sleeve which extends a minimum of five (5) feet on either side of the potable water piping. Provide a minimum vertical clearance of six (6) inches.
7. Use only strap-type friction wrenches for threaded plastic pipe.
8. Snake pipe from side to side within the trench.

F. Line Clearance
1. All lines shall have a minimum clearance of six (6) inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.

G. Irrigation Controller Installation
1. Install the irrigation controller per the manufacturer's instructions. Remote control valves shall be connected to the irrigation controller in numerical sequence as indicated on the Drawings.

H. High Voltage Wiring for the Irrigation Controller
1. 120 volt power connection to the irrigation controller shall be provided by the Contractor.

I. Electric Control Valve Installation
1. Install electric control valves as indicated on the Drawings. When grouped together, allow at least twelve inches between electric control valves. Install each electric control valve in a separate valve box. Each electric control valve number shall be heat-branded on valve box top with 2" tall letters.
2. The Owner’s Authorized Representative shall approve electric control valve and quick coupling valve box locations prior to final installation.

J. Valve Box Installation
1. Install valve boxes as indicated on the Drawings. When grouped together, allow at least twelve inches between valve boxes.
2. Heat brand valve box identification as indicated on Drawings. Heat branding unit available from Hydro-Scape Products, Inc., phone number (714) 639-1850 or approved equal.

K. System Flushing
1. After all pipe lines and risers are in place and connected and all necessary diversion work has been completed, and prior to installation of sprinkler heads, the control valves shall be opened and a full head of water used to flush out the system. Sprinkler heads shall be installed only after flushing of the system has been performed.

L. Sprinkler Head Installation
1. Install the sprinkler heads as indicated on the Drawings.
2. Spacing of sprinkler heads shall not exceed the maximum spacing as indicated on the Drawings. In no case shall the spacing exceed the maximum recommended by the manufacturer.
3. Install check valves on sprinkler heads that drain water after the control valve is turned off. "Low head" drainage will not be allowed on sprinkler heads.

M. Sleev ing
1. Extend sleeve ends a minimum of 12 inches beyond the edge of the paved surface. Cover pipe ends and mark with stakes. Route wire through and tie at each end to stakes.

3.4 TEMPORARY REPAIRS

A. The Owner reserves the right to make temporary repairs as necessary to keep the irrigation system in operating condition. The exercise of this right by the Owner shall not relieve the Contractor of his responsibilities under the terms of the Guarantee as herein specified.

3.5 INSTALLATION OF OTHER COMPONENTS
A. Tools and Spare Parts
   1. Prior to the Pre-Maintenance Walk-through, supply the Owner operating keys, servicing tools, test equipment, and any other items as indicated on the Drawings.

B. Other Materials
   1. Install other materials or equipment to be part of the irrigation system, as indicated on the Drawings, even though such items may not have been referenced in this Specification.

3.6 EXISTING TREES

A. Where it is necessary to excavate adjacent existing trees, the Contractor shall use all possible care to avoid injury to trees and their roots. Excavation in areas where two (2) inch and larger roots occur shall be done by hand. All roots two (2) inches 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. Where a ditching machine is run close to trees having roots smaller than two (2) inches in diameter, the wall of the trench adjacent to the tree shall be hand trimmed. Trenches adjacent to existing trees should be closed within 24 hours. Where this is not possible, the side of the trench adjacent to the existing tree shall be kept shaded with burlap or canvas.

3.7 FIELD QUALITY CONTROL

A. Adjustment of the Irrigation System
   1. Flush and adjust all sprinkler heads for optimum performance and to reduce overspray onto walks, roadways, and buildings as much as possible.
   2. If it is determined that adjustments to the sprinkler heads will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to any planting. Adjustments may also include changes in nozzle sizes and degrees of arc as required.
   3. Lowering raised sprinkler heads by the Contractor shall be accomplished within 10 days after notification by the Owner's Authorized Representative.
   4. All sprinkler heads shall be set perpendicular to finish grades unless otherwise indicated on the Drawings.

B. Irrigation System Testing
   1. The Contractor shall request the presence of the Owner's Authorized Representative at least 48 hours in advance of irrigation system testing.
   2. Test all pressure lines under hydrostatic pressure of 150 PSI for a period of two (2) hours.
      Note: Testing of pressure mainline shall occur prior to installation of any
3. All piping (pressure and non-pressure) under paved areas shall be pressure tested under a hydrostatic pressure of 150 PSI for a period of two (2) hours.

4. If during the pressure test, a pressure drop occurs - indicating a leak, replace the faulty joints and repeat the pressure test until the entire system is proven watertight.

5. All hydrostatic tests shall be made only in the presence of the Owner's Authorized Representative. No pipe shall be backfilled until it has been observed, tested and approved in writing.

6. The Contractor is to furnish the necessary force pump and all other test equipment for the hydrostatic pressure test.

7. When the irrigation system passes the hydrostatic pressure test and is completed, perform a sprinkler coverage test in the presence of the Owner's Authorized Representative. Determine if the water coverage is complete and adequate. Furnish all materials and perform all work necessary to correct any inadequacies of water coverage due to deviations from the Drawings, or where the irrigation system has been willfully installed as indicated on the Drawings when it is obviously inadequate, without bringing this to the attention of the Owner's Authorized Representative. This test shall be accomplished before any groundcover or turf is planted.

8. Upon completion of each phase of work, the entire system shall be coverage tested and adjusted to meet specific site requirements.

3.8 IRRIGATION SYSTEM MAINTENANCE

A. The entire irrigation system shall be under full, automatic operation for a period of seven (7) days prior to beginning any planting. The Owner reserves the right to waive or shorten this operation period.

3.9 CLEAN UP

A. Clean up shall be made as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broom swept or washed down, and any damage sustained to the work of other contractors shall be repaired to original conditions at no cost to the Owner.

B. Upon completion of the Work, the Contractor shall smooth all ground surfaces. Remove excess materials such as rubbish, debris and sweep adjacent streets, curbs, gutters, walkways and trails. Remove construction equipment from the premises.

3.10 FINAL WALK-THROUGH PRIOR TO ACCEPTANCE

A. The Contractor shall operate the irrigation system in its entirety for the Owner's
Authorized Representative at time of the Final Walk through. Any items deemed not acceptable by the Owner's Authorized Representative shall be reworked to his complete satisfaction.

B. The Contractor shall show evidence to the Owner's Authorized Representative that the Owner has received all accessories, charts, "As-built drawings", and equipment as required before the Final Walk-through will be performed.

3.11 SITE VISIT OBSERVATION SCHEDULE

A. The Contractor shall be responsible for notifying the Owner's Authorized Representative in advance of the following site visits:
   1. Pre-Job or "Kick-Off" meeting - 7 days.
   2. Pressure supply line installation and testing - 2 days.
   3. Automatic controller installation - 2 days.
   4. Control wire installation - 2 days.
   5. Lateral line and sprinkler head installation - 2 days.
   6. Sprinkler coverage test - 2 days.
   7. Final Walkthrough - 7 days.

B. When site visits are conducted by other than the Owner's Authorized Representative, show evidence in writing of when and by whom these site visits were made.

D. No site visits will commence without "As-builts". In the event the Contractor schedules a site visit without "As-builts" or without completing previously noted corrections, or without preparing the system for said visit, the Contractor be responsible for reimbursing the Owner's Authorized Representative at his current billing rate per hour portal to portal (plus transportation costs) for this inconvenience. No further site visits will be performed by the Owner's Authorized Representative until this charge has been paid and received.

END OF SECTION
SECTION 02810-A

LANDSCAPE IRRIGATION DRIPLINE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the installation of low volume irrigation components including Control Zone Kits, Landscape Dripline, Fittings and Emission Devices.

PART 2 – DRIP IRRIGATION PRODUCTS

2.1 CONTROL ZONE KITS

A. General

1. Control zone kit assemblies for drip irrigation zones must include a valve, filtration and pressure regulation to meet the flow requirements of the zone. Where necessary a check valve shall also be installed.

2. Control zone kits shall be Rain Bird control zone kits as indicated on construction drawings.

3. Components shall be sized according to the hydraulic demands of the system.

B. Basket Filter

1. Commercial Control Zone Kit for zones with flows from 3.0 to 20.0 GPM

   a. Control Zone Kit shall be Rain Bird’s Commercial Control Zone Kit with Rain Bird’s 1” PESB valve, Quick Check Basket Filter with 200-mesh (75 micron) screen and 40 psi Pressure Regulator.

   b. The control zone kit shall have a 1” isolation ball valve.

   c. The filter shall be a 1” inline Quick Check Basket Filter body constructed of heavy-duty, glass-filled, UV resistant polypropylene capable of withstanding pressures of not less than 150 psi (10,3 bars). The design shall be a basket style body with jar-top cap. The cap shall incorporate an indicator that goes from green to red during operation when the filter element needs cleaning. The dimensions for the filter shall not exceed the following: Height: 6 1/2” (16,5 cm), Length: 6 1/2” (16,5 cm), Width: 3 1/2” (8,9 cm). The filter element shall be constructed of a durable stainless steel mesh attached to a propylene frame and shall be a standard 200-mesh (75 micron). The screen shall be
serviceable for cleaning purposes by unscrewing the cap from the body and removing the filter element.

d. The control zone kit shall have an inline pressure regulator. The pressure regulator shall be constructed of durable, UV resistant non-corrosive material able to accommodate an inlet pressure rating of not less than 150 psi (10,3 bar). The pressure regulating device is a normally open device that allows full flow with little pressure loss unless the inlet pressure is greater than the preset level. As the inlet pressure increases above the preset level it compresses a spring and begins to reduce the flow and downstream pressure. The inline pressure regulator shall have a preset outlet pressure of approximately 40 psi (2,8 bar).

e. The control zone kit shall have a 1” Rain Bird PESB series automatic irrigation control valve. The valve pressure rating not to be less than 150 psi (10,3 bars). The valve body and bonnet shall be constructed of high-impact, weather-resistant plastic, stainless steel and other chemical/UV resistant materials. The valve shall have a diaphragm constructed of a durable Buna-N rubber material reinforced with nylon.

f. Model: Medium Flow Kit with 1” PESB Valve, Basket Filter with 200 mesh (75 micron) screen, 40 psi Pressure Regulator and ball valve. XCZ-100-B-COM

2.1 LANDSCAPE DRIPLINE

B. Inline Emitter Tubing

1. Pressure-Compensating Rain Bird Landscape Dripline

   a. The inline emitter shall be welded to the inner circumference of the polyethylene tubing. The inline emitter shall have dual outlet ports, 180° apart, ensuring only one port has contact with the ground when the tubing is installed at grade and mulched over.

   b. Rain Bird’s ADI emitter (Advanced Drip Inline) shall pressure compensate by lengthening the emitter’s turbulent flow path. The emitter shall be cylindrical in shape and provide surface area for filtration throughout 360° of its outer circumference. This increased filtration surface area shall assure that the water that enters the inline emitter can always come from the upper half, or cleanest part of the flow path in the polyethylene tubing regardless of how the inline tubing lays on the ground.

   c. Rain Bird Landscape Dripline tubing shall be brown in color and conform to an outside diameter (O.D.) of 0.630 inches (16 mm) and an inside diameter (I.D.) of 0.540 inches (13,7 mm) and wall thickness of 0.045 inches (1,1 mm).
d. Rain Bird Landscape Dripline shall have factory installed, pressure-compensating, inline emitters installed every [12] or [18] or [24] inches. OR
e. Rain Bird Landscape Dripline shall have factory installed, pressure-compensating, inline emitters with spacing as indicated on drawings.
f. The flow rate from each installed inline emitter shall be a consistent [0.6] or [0.9] gallons per hour when inlet pressure is between 8.5 and 60 psi (0.7 to 4.1 bars).
g. Operating pressure range: 8.5 to 60 psi (0.7 to 4.1 bar).
h. Pressure-Compensating Landscape Dripline for non-potable water systems:
   Rain Bird Purple Landscape Dripline [with emitters and spacing as shown on construction drawings].
i. Rain Bird Landscape Dripline LD-P-09-12 (0.9GPH emitters spaced 12” on center)

2.3 FITTINGS

A. Compression Fittings

1. Easy Fit Compression Fittings:
   a. The Easy Fit Compression Fitting System shall consist of 3 fittings (tee, coupling and elbow) plus 5 adapters and two removable flush caps.
   b. The Easy Fit Compression Fittings shall accept all polyethylene tubing from .630" to .710" (16mm-18mm) OD and shall provide a leak-free compression fit. They also shall provide connections to threaded components when used with any of the 5 adapters. The fittings shall be molded from UV-resistant ABS material with a Buna-N rubber seal for long-term, leak free connections.
   c. The adapters shall be made of UV-resistant ABS materials and shall only be used with Easy Fit Compression Fittings. The adapters shall be installed in the Easy Fit Compression Fittings and threaded onto ½" or ¾" Male- or Female-threaded components. Pressure loss for the Easy Fit Adapters is a maximum of .1 PSI for each adapter used.
   d. The removable [black] or [purple] flush cap shall be used to close off a line. The purple flush cap shall be used to close off a line containing non-potable water.
   e. The operating pressure range for the Easy Fit Compression Fitting System shall be 0 to 60 psi (0 to 4.1 bars).
   f. Models:
      i. Tee: MDCFTEE
      ii. Coupling: MDCFCOUP
      iii. Elbow: MDCFEL
      iv. Below Grade Irrigation Emission Stake: BIGIESTK
      v. Adapters:
         I. ½” Male pipe thread adapter: MDCF50MPT
         II. ¾” Male pipe thread adapter: MDCF75MPT
III. ½” Female pipe thread adapter: MDCF50FPT
IV. ¾” Female pipe thread adapter: MDCF75FPT
V. ¾” Female hose thread adapter: MDCF75FHT
vi. Provide purple flush caps for non-potable zones: MDCFPCAP

END OF SECTION
PART 1  GENERAL

1.1  SECTION INCLUDES

A.  Galvanized steel chain-link fabric.

B.  PVC coated steel chain-link fabric.

C.  Privacy slats.

D.  Galvanized steel framework and fittings for fencing and gates.

E.  Barbed wire.

1.2  RELATED SECTIONS

A.  Section 02300, Earthwork.

B.  Section 03301, Minor Concrete.

1.3  RELATED DOCUMENTS

A.  Caltrans Standard Specifications:
   1.  Section 80, Fences.

B.  Caltrans Standard Plans:
   1.  Plan A85, Chain Link Fence.

C.  ASTM:

1.4  DEFINITIONS

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Experienced who has completed chain-link fences and gates similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Chain Link Fences and Gates: Obtain each color, grade, finish, type and variety of components for chain-link fences and gates from one source with resources to provide chain-link fences and gates of consistent quality in appearance and physical properties.

1.6 SUBMITTALS

A. Submittal procedure shall be as outlined in Section 01330.

B. Product Data: Material description, construction details, dimensions or individual components and profiles, and finishes for the following.
   1. Fence and gate posts, rails and fittings.
   2. Chain link fabric, reinforcement, and attachments.
   3. Gates and hardware.
   4. Barbed wire.
   5. Concrete design mix.
   6. PVC coating.
   7. Privacy slats.

PART 2 PRODUCTS

2.1 MATERIALS


B. Fabric: Black vinyl coated, Caltrans Standard Specifications, Section 80-4.01B.

C. PVC Coated Fabric: ASTM F 668, Class 2A or 2B over fabric specified above. Color as indicated.


E. Barb Arms: Galvanized pressed steel, ASTM F 626, of a type that can be attached to the tops of the posts with each arm carrying three wires at approximately 5-1/2 inch on center in a vertical plane, in a plane approximately 45 degrees from the vertical or
in two 45-degree planes from the vertical forming a V. Arm configuration shall be as indicated.

F. Barbed Wire: ASTM A 121, 12 1/2 wire gage, two strands twisted with 2 point barbs spaced not more than 5-inches. Zinc coating for line wire and wire for barbs shall be chain link fence grade, minimum class 3 coating weight.

G. Portland Cement Concrete for Footings: Section 03301.

H. Miscellaneous: Tension wire, tie wire, hog rings, post clips, turnbuckles, truss tighteners and concrete for post footings shall comply with Caltrans Standard Specification Section 80-4.01C.

I. Privacy Slats: Type as indicated on the Plans.
   1. PVC: UV-light stabilized, not less than 0.023-inch thick, sized to fit mesh specified for direction indicated. Color as indicated.
   2. Fiber-glass-reinforced plastic: UV light stabilized, not less than 0.06-inch thick, sized to fit mesh specified for direction indicated. Color as indicated.
   3. Redwood: 5/16-inch thick, sized to fit mesh specified for direction indicated.

PART 3 EXECUTION

3.1 SITE PREPARATION

A. Earth, trees, brush and other obstructions which interfere with the proper construction of fences will be removed and disposed of, unless the Owner’s Representative orders certain trees to remain. Do not begin installation before final grading is completed, unless otherwise permitted by the Owner’s Representative.

3.2 CONSTRUCTION

A. General: Caltrans Standard Specifications, Section 80-4.02 and Caltrans Standard Plan A85.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

C. Place concrete around posts and vibrate or tamp for consolidation. Protect portion of posts above ground from splatter. Verify that posts are set plumb, aligned and at correct height and spacing. Extend concrete 2-inches above grade, smooth and shape to shed water.
D. Spoils: Dispose of spoils from excavations for fence and gate footings in an area designated by the Owner’s Representative. Spread spoils material thinly and uniformly to form a smooth surface that does not trap water.

E. Privacy Slats: Install slats in direction indicated, securely locked in place.

F. Barbed Wire: Install 3 strands on each barb arm uniformly spaced. Pull wire taut and secure to extension arms, end posts or terminal arms.

END OF SECTION
SECTION 02900
LANDSCAPE PLANTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Furnish all materials, labor, transportation, services, and equipment necessary to install landscape planting as shown on the Drawings and as specified herein.

B. Work included in this Section:
   1. Fine grading.
   2. Soil preparation on grade.
   3. Tree, shrub and ground cover planting.
   4. Tree staking and guying.
   5. Mulching.
   6. Clean-up.

C. Work related in other Sections:
   1. Section 02780– Unit Paving – Concrete Pavers.
   2. Section 02810– Landscape Irrigation
   4. Section 02970– Operation and Maintenance of Planting.

1.02 DEFINITIONS

A. The Owner in this Section will refer to the Landscape Architect.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. All Federal, State, and local laws and regulations governing this work are hereby incorporated into and made part of this Section. When this Section calls for certain materials, workmanship or a level of construction that exceeds the level of Federal, State, or local requirements, the provisions of this Section shall take precedence.

1.04 REFERENCE STANDARDS

A. All plant material shall be true to botanical and common name as indicated in "An Annotated Checklist of Woody Ornamental Plants of California, Oregon and Washington", (Number 4091)” published by the University of California School of Agriculture - 1979.


C. Hortus Third", 1976; Cornell University for plant nomenclature.

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D. All plant material shall conform to the California State Department of Agriculture's regulation for nursery inspections, rules and ratings.

1.05 QUALITY CONTROL

A. Manufacturer's Directions - manufacturer's directions and drawings shall be followed in all cases where the manufacturers of articles used in this Specification furnish directions covering points not shown in the Drawings and Specifications.

B. Permits, Fees, Bonds and Inspections - the Contractor shall pay for any and all permits, fees, bonds and inspections necessary to perform and complete his portion of the Work.

C. Plant Source Quality - submit written documentation to the Owner within 25 days of Contract award that the plant material listed on the Drawings is available. Any substitutions required due to unavailability must be requested in writing prior to confirmation of ordering.

D. Upon execution of the order, the Owner has the option of either inspecting the plant material at the source of growth, requesting representative color photos, or inspecting the material as it is being delivered to the site for conformity to the Drawings and Specifications. Such approvals shall not impair the right of additional inspections during further progress of the Work.

E. Any tagging of plant material by the Owner does not constitute his approval of the plant materials' health and vigor. The health and vigor of the plant material is the sole responsibility of the Contractor.

F. Plant Inspection Request.

G. Submit written request to the Owner for inspection of the specified plant material, either at the place of growth or by color photographs. Requests for inspection shall state the place of growth and the quantity and variety of plant material.

H. The Owner reserves the right to refuse inspection if in his judgment, a sufficient quantity of plant material at that time is not available for inspection.

I. Topsoil Inspection

J. Within 25 days of contract award, furnish source of topsoil to the Owner for purpose of soil inspection.

K. Take representative soil samples from areas identified in the Drawings.

L. Soil samples shall be tested for pH, alkalinity, total soluble salts, porosity, sodium content, organic matter and soil preparation recommendations.

1.06 QUALIFICATIONS
1.07 SUBMITTALS

A. The Contractor shall submit no later than 30 days after the award of Contract (2) bound booklets containing the following landscape information:

1. List of all proposed landscape materials indicated by description, manufacturer and model number. Include catalog cuts of all items.

2. List of all trees indicated by botanical name, common name, quantity, size, nursery and location and any specific remarks, i.e. "unable to locate", "photo submitted", etc. The tree list is to be accompanied with color photographs of each tree type and size with specifications, i.e. height, spread and caliper. Include a person in each photograph for scale purposes.

3. List of all shrubs, vines and ground covers indicated by botanical name, common name, size, nursery and location and specific remarks, i.e. "unable to locate", "photo submitted", etc.

4. Soil amendment receipts containing analytical data and physical samples of all specified amendments.

5. Receipts from the soil supplier of all soil mixes specified in this section.

B. The Contractor shall submit no later than 30 days after the award of Contract the following physical samples sent to the Owner in plastic bags:

1. Shredded bark mulch.

2. Certificates

3. Compliance with State of California and federal quarantine restrictions.

C. Weed Control

1. Prior to the installation of any weed control materials, the Pest Control Advisor shall submit to the Owner, a list of the weed control materials and quantities per acre intended for use in controlling the weed types prevalent and expected on the site.

2. The Pest Control Advisor shall furnish data to demonstrate the compatibility of the weed control materials and methods with the intended planting and seed varieties.

1.08 SUBSTITUTIONS

A. Substitutions shall be in accordance with Division 1.

B. Specific reference to manufacturer's names and products specified in this Specification are used as standards of quality, this implies no right to the Contractor to substitute other materials without prior written approval by the Owner.
C. Any materials installed without written approval by the Owner may be rejected.

D. If an approval is granted for a substitution, adjustment in the Contract amount will be made in accordance with the Contract Conditions.

1.09 SAMPLES, TESTS AND MOCK-UPS

A. The Owner reserves the right to take and analyze selected samples of plant material for conformity to this Specification at any time. Rejected plant material shall be removed from the site and be replaced by the Contractor at no cost to the Owner.

1.10 PROJECT CONDITIONS

A. Perform planting operations only when weather and soil conditions are suitable in accordance with locally accepted practice.

1.11 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery
1. Deliver all plant material with legible and durable identification labels.
2. Deliver fertilizer to the site in original, unopened containers bearing the manufacturer's name, guaranteed chemical analysis, and its conformance to California State Law.
3. Notify the Owner within seven (7) days of the delivery of plant material to the site. Indicate the quantity and type of plant material in each delivery.

B. Storage
1. Store plant materials in the shade and protect from the weather.
2. Maintain and protect plant material not planted within four (4) hours of delivery.

C. Protection
1. Protect plant material during delivery and to the site and after, in order to prevent damage to the root ball or desiccation of leaves.

D. Handling
1. Take extreme care in the loading and unloading of plant material. Do not pick up container plants by the stems or trunks.
2. Any plant material that has been damaged due to mishandling shall be removed and replaced with new material.

1.12 REJECTION OF PLANT MATERIAL

A. All plant material not conforming to the requirements herein, shall be considered defective. Such plants, whether in place or not, shall be marked as rejected and immediately removed from the site and replaced with new material at the full expense of the Contractor. Replacement plant material shall be of the same size, specie and condition as that indicated on the Drawings.
1.13 PROTECTION OF THE SITE

A. Protect previously installed work and materials which may be affected by work of this Section. Provide safeguards and exercise caution against injury or defacement of existing site improvements.

B. The Contractor shall be responsible for any damage resulting from his landscape planting operations. Repair damage and return the area to the previous condition at no additional cost to the Owner.

1.14 COORDINATION

A. The Contractor shall notify the General Contractor and all other trades related to the installation of his work, so as to allow sufficient time for those contractors’ to perform their portion of the work.

B. Determine the locations of underground utilities and perform work in a manner which will avoid damage to the utilities.

1.15 GUARANTEE

A. The manufacturer's warranty shall not relieve the Contractor of his own liability under the guarantee. Such warranties shall only supplement the guarantee.

B. All plant material installed under this Contract shall be guaranteed against poor, inadequate and inferior quality and installation for a period of 1 year from the date of Final Acceptance. Palm trees, however, shall be guaranteed for a period of 2 years, refer to Palm Tree Planting - Section 02955. Any plant material not meeting the satisfaction of the Owner shall immediately be removed and replaced at no cost to the Owner. Replaced plant material will also be guaranteed for a period of 1 year (palm trees for 2 years) upon installation.

C. Replace without cost to the Owner and as soon as weather permits, all dead plants and all plants not found in a vigorous, thriving condition, as determined by the Owner during and at the end of the plant warranty period. Replacement of plants shall closely match adjacent specimens of the same specie and shall be subject to all requirements of this section.

D. Repair damage to adjacent plant material caused by the Contractor's work at no cost to the Owner. All repairs shall be made with materials, varieties, sizes "in kind" with adjacent existing materials.

E. Guarantee for Planting

We hereby guarantee that the planting we have furnished and installed is free from defects in materials and workmanship and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse or neglect excepted. We agree to replace plants 15 gallons and larger for one (1) year after
acceptance due to plant’s dying or partially dying, thereby damaging shape, size or symmetry. Including damages consequential to defects in materials and workmanship and repair or replacement, which develop during one (1) year after Final Acceptance of the work, at no additional cost to the Owner. We agree to make such repairs and replacements within thirty (30) days after receipt of written notice. In the event of our failure to make such repairs and replacements within thirty (30) days of written notice, we authorize the owner to proceed to have such repairs and replacements made at our expense and will pay all costs and charges upon demand:

Triana
Canoga Park, CA
Date of Final Acceptance:
Signed:
Company Name:
Address:

PART 2 - PRODUCTS

2.01 PRE-EMERGENT WEED CONTROL

A. Pre-emergent weed control to be Ronstar-G, Treflan, Eptam, Vegitex, or approved equal.

2.02 PLANTING SOIL

NOTE: 11.30.07 – BELOW IS A DRAFT PLANTING SOIL SECTION ONLY - UNTIL TESTING OF VARIOUS LOCATIONS OF EXISTING SOIL AND IRRIGATION WATER CONDITIONS IS TAKEN AT SITE TO DETERMINE IF ANY IMPORT SOIL WILL BE REQUIRED. CONTRACTOR ESTIMATES SHOULD QUALIFY THAT THEIR BIDS “DO” OR “DO NOT” INCLUDE IMPORT TOP SOIL FOR PLANTING.

A. Reuse of Stockpiled On-Site Soil
1. Stockpiled on-site soil may be available from the Owner's stockpile for use. Soils for turf beds are classified as 3/8" minus. Soils for miscellaneous landscape areas are classified as 2-inch minus.

B. Soil Characteristics for Stockpiled Native Soil
1. Composition for 3/8-inch minus topsoil - fertile, friable, well-drained soil of uniform quality, free of materials larger than 3/8" in diameter such as sticks, rocks, concrete, oils, chemicals and other deleterious materials.
2. Composition for 2-inch minus topsoil - fertile, friable, well-drained soil of uniform quality, free of materials larger than 2" in diameter such as sticks, rocks, concrete, oils, chemicals and other deleterious materials.
3. Soil Analysis - If soil has not been tested within 30 days of the date of delivery to the project, obtain an agricultural suitability and chemical analysis of the proposed soil from a company as determined by the Owner. Cost of the testing
will be paid for by the Contractor. The soil report is to include the following information:


5. Other: pH factor, % base saturation, electrical conductivity, mechanical analysis, % of organic content, cation exchange capacity (C.E.C.).

6. Recommendations: Type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring topsoil to a satisfactory level for planting.

7. All stockpiled native soil to be used from 3/8-inch minus topsoil is to be amended at the levels listed in this Section as part of the base bid. Additional amendments, if requested by the Owner are not part of the contract and the Contractor will be compensated for this work on a Time and Materials basis. Rates for labor and equipment will be charged according to the Construction Contract.

C. Imported Top Soil

1. In order to insure conformance with this Specification, soil samples shall be taken by the Contractor and submitted to a qualified soil testing laboratory for analysis prior to planting i.e., Wallace Laboratories (310) 615-0116

2. Use natural friable soil of the local region, free from lumps, toxic substances, debris, vegetation or stones over 1-inch in diameter.

3. Silt plus clay content shall not exceed 20% by weight with a minimum 95% passing the 2.0 millimeter sieve.

4. Sodium absorption ratio (SAR) shall not exceed 6.

5. Electrical conductivity (ECE) of the saturated extract of this soil shall not exceed 3.0 milhoths per centimeter at 25 centigrade.

6. Boron content shall not exceed (1) part per billion as measured on the saturation extract.

7. Thoroughly blend the planter mix and amendments through a soil blender before placing the soil.

8. Thoroughly blend the soil mix and amendments through a soil blender before placing the soil.

2.03 SOIL AMENDMENTS

A. Peat Moss - natural product of sphagnum moss, reed, or sedge peat, taken from a fresh water site, free from lumps, woody material, stones and other foreign matter.

B. Soil Sulfur - agricultural grade sulfur containing a minimum of 99% sulfur (expressed as elemental).

C. Iron Oxide - 45% iron (expressed as metallic iron), derived from iron oxide with micronutrients.

D. Calcium Carbonate - 95% lime as derived from oyster shells.

E. Gypsum - agricultural grade product containing 98% minimum calcium sulfate.
F. Iron Sulfate - 20% iron (expressed as metallic iron), derived from ferric and ferrous sulfate, 100% sulfur (expressed as elemental).

G. Ground Limestone - agricultural limestone containing not less than 85% of total carbonates, ground to such fineness that 50% will pass a #1000 sieve and 90% will pass a #20 sieve.

H. Dolomite Lime - agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum carbonate, 100% passing the #65 sieve.

I. Sulfate of Potash - agricultural grade product containing 50% to 53% of water soluble potash.

J. Single Superphosphate - commercial grade product containing 20% to 25% available phosphoric acid.

K. Ammonium Sulfate - commercial grade product containing approximately 21% ammonia.

L. Ammonium Nitrate - commercial grade product containing approximately 34% ammonia nitrogen.

M. Urea Formaldehyde - granular commercial product containing 38% nitrogen.

N. IBDU (Iso Butldiene Diurea) - commercial grade product containing 31% nitrogen.

O. Iron: Gro-Power Premium Green Iron - 45% Fe, non-staining.

2.04 FERTILIZERS

A. General Purpose Soil Conditioner Fertilizer (5-3-1)
   1. Consisting of the following minimum percents by weight:
      5% Nitrogen
      3% Phosphoric Acid
      1% Potash
      50% Humus
      15% Humic Acids
      1% Soluble Metallic Iron
   2. Soil Conditioner Fertilizer shall be "Gro-Power", as manufactured by Gro-Power (909)393-3744 or equivalent.

B. General Purpose Soil Conditioner Fertilizer with Soil Penetrant (5-3-1)
   1. Soil conditioning fertilizer for use in areas of clay, adobe soils or soils high in salt, sodium boron or pH consisting of the following minimum percents by weight:
      5% Nitrogen
      3% Phosphoric Acid
1% Potash
50% Humus
15% Humic Acids
4% Sulfur
1% Soluble Metallic Iron

2. Soil Conditioner Fertilizer with Soil Penetrant shall be “Gro-Power Plus” as manufactured by Gro-Power (909) 393-3744 or equivalent.

C. Pre-Plant Fertilizer (16-20-0)
1. Ammonium phosphate consisting of the following minimum percentages by weight:
   16% Nitrogen
   20% Phosphoric Acid
   0% Potash
2. Pre-Plant Fertilizer shall be Best "16-20-0", as manufactured by J.R. Simplot Company (800)992-6066, or equivalent.

D. General Purpose Planting Fertilizer (12-12-12)
1. Pelleted or granular form shall consist of the following minimum percents by weight:
   12% Nitrogen
   12% Phosphoric Acid
   12% Potash
2. General Purpose Planting Fertilizer shall be Best "Triple Twelve", as manufactured by J.R. Simplot Company (800)992-6066, or equivalent.

E. Controlled Release Fertilizer (12-8-8)
1. Consisting of the following minimum percents by weight:
   12% Nitrogen
   8% Phosphoric Acid
   8% Potash
   25% Humus
   5% Humic Acids
2. Acceptable product - "Gro-Power Controlled Release", as manufactured by Gro-Power (909)393-3744, or equivalent.

F. Planting Tablets (20-10-5)
1. Shall be 7 gram, 24 month release, non-burning tablets containing the following percentages of nutrients by weight:
   20% Nitrogen
   10% Phosphoric Acid
   5% Potassium
   2.5% Humic acids
2. Acceptable product - "Gro-Power Planting Tablets", as manufactured by Gro-Power (909)393-3744, or equivalent.

2.05 PLANT MATERIAL
A. General Plant Condition
1. All plant material delivered to the site shall have a normal habit of growth, well-formed and shaped, healthy, vigorous, and free of any insects, diseases, sunscalds, windburn, abrasions of the bark, or other objectionable disfigurements.
2. The size of the plant material shall correspond with that normally expected for species and variety of commercially nursery stock or as specified on the Drawings.
3. Plant material shall be grown under climatic conditions similar to those in the locality of the project unless approved otherwise by the Owner.
4. The use of plant material larger than that specified on the Drawings may be used, pending approval from the Owner, however, there will be no change in the Contract amount if the larger plant material is approved and used.

B. Trees and Shrubs
1. Tree and shrub trunks shall be sturdy and well hardened with vigorous and fibrous root systems which are not root-bound.
2. In the event of a disagreement as to the condition of the root system, the root conditions of the plants furnished by the Contractor will be determined by the removal of soil around the roots of not less than 10 plants or more than 2% of the total number of plants of each specie.
3. When container grown plants are supplied from several sources, the roots of not less than 10 plants of each specie from each source will be inspected. In case the plants sampled are found to be defective, the Owner has the right to reject the entire lot represented by the defective sample. Any plant material rendered unsuitable for use because of this inspection will be considered as samples and will be provided at the full expense of the Contractor.
4. Washingtonia robusta palm trunks to be skinned with approximately 4’ of fronds left at base of trunk.

C. Nursery Grown and Collected Stock
1. Nursery grown and collected stock shall be grown under climatic conditions similar to that found in the locality of the site.

D. Container Grown Stock
1. Container grown stock shall be in a vigorous and healthy condition, not root bound or with the root system hardened off.

E. Ground Cover Stock
1. Ground cover stock shall be well established in removable containers or having formed homogenous soil sections.

2.06 AUXILIARY ACCESSORIES
A. Tree Stakes
1. Wood stakes - 2” diameter by 10 feet Lodgepole Pine stake without splits or bowing. Refer to the Drawings for which trees receive wood stakes.

B. Tree Ties
1. Wonder Tree-Tie as distributed by Hydro-Scape Products, Inc. (714)639-1850, or approved equal.

C. Tree Guying Hardware
1. Guy Wire - #9 gage, galvanized twisted wire - clear plastic coated. 
Deadman - Duckbill Earth Anchoring System, Model #68-DB1, or equal. 
Hose - 3/4” reinforced black rubber garden hose. 
Warning Guy Wire Tube - 5’ long x 1/2” dia. white Class 315 PVC pipe. 
Turnbuckles - 6” long, galvanized eye/hook type. 
Wire Clamps - 3/4” galvanized "U" clamps.

D. Concrete and Composite Headerboard Layout
1. Refer to Construction details as specified on the Drawings. 
2. Headerboard and concrete mowstrip shall be laid true to line and grade. Protect adjacent improvements from damages. Stakes shall be placed on the ground cover side of the headerboards.

E. Mulches
1. Shredded Bark Mulch 
   a. Bark mulch noted as "Early Vineyart” bark mulch, manufactured and supplied by Sonoma Compost (707) 664-9113, or equivalent. Sample of mulch be submitted to Owner and Approved by Bureauveritas.

F. Tree Root Barriers
1. Tree root barriers as supplied by Deep Root Corporation (Catalog #UB 24-2) 
or Root Solutions Root Guide Barrier by Root Solutions, Inc. (415)434-3072, or approved equal.

PART 3 - EXECUTION

3.01 RENOVATION AND PREPARATION OF EXISTING SOIL

NOTE: 11.30.07 – BELOW IS A DRAFT SOIL PREPARATION SECTION ONLY - UNTIL TESTING OF VARIOUS LOCATIONS OF EXISTING SOIL AND IRRIGATION WATER CONDITIONS IS TAKEN AT SITE TO DETERMINE IF ANY IMPORT SOIL WILL BE REQUIRED. CONTRACTOR ESTIMATES SHOULD QUALIFY THAT THEIR BIDS “DO” OR “DO NOT” INCLUDE IMPORT TOP SOIL FOR PLANTING.

A. Contractor shall prepare Horticultural soil samples taken in (6) selected locations for initial horticultural analysis and soil amendment recommendations:
Soil Sample #1: Soil Sample #4: 
Soil Sample #2: Soil Sample #5: 
Soil Sample #3: Soil Sample #6:

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B. Contractor shall perform soil renovation procedures to the soil as required by soils report.

3.02 CULTIVATION OF EXISTING SOIL

A. In areas where topsoil will not be applied, rip or cultivate the existing soil that will be receiving planting to a depth of at least 10-inches immediately prior to applying soil amendments.

B. In areas where topsoil will be applied the following procedures are to be followed:

C. Verify that subgrades for installation of topsoil have been established under rough grading, subgrade depth plus specified depth of topsoil should equal finished grade. Do not spread topsoil prior to the Owner acceptance of all subgrade work.

D. Rip or cultivate subgrade in all planting areas to a minimum depth of 10-inches immediately prior to spreading topsoil.

E. Remove all rocks, stones, sticks and debris larger than 1-inch in diameter from the surface of the subgrade prior to applying topsoil.

3.03 SOIL SCARIFICATION

A. Planting areas which become compacted in excess of 85% relative compaction due to construction activities, shall be thoroughly cross-ripped to a minimum depth of 9” to alleviate the condition, taking care to avoid existing subsurface utility lines, if present.

3.04 VERIFICATION OF EXISTING CONDITIONS

A. Prior to the work in this Section, examine previously installed work from other trades and verify that such work is complete and as required, to the point where this installation may commence properly.

3.05 ROUGH GRADING CERTIFICATION

A. Obtain the Owner's written certification that indicates that final rough grade have been set by previous contractors to plus or minus 0.10' prior to commencing fine grading operations.

3.06 FINE GRADING OPERATIONS

A. Insure that the top 2-inches of soil is free of stones, roots, stumps, wire, or other deleterious matter 1-inch in diameter and larger. Dispose of debris offsite.

B. All planting areas to be fine graded to within 1-1/2-inches of paved areas, irrigation valve boxes, concrete mow strips and headerboards.
C. Upon acceptance of rough grade by the Owner and prior to beginning planting operations, finish grade all planting areas, fill as needed and remove surplus soil and float areas to a smooth, uniform grade to elevations as indicated on the Drawings. Obtain the Owner approval of the fine grading prior to commencing planting operations.

3.07 SURFACE DRAINAGE OF PLANTING AREAS

A. The Contractor shall bear final responsibility for properly draining all planting areas. Any discrepancy in the Drawings or Specifications, obstructions on the site, or prior work done by another contractor, which the Contractor feels precludes establishing proper drainage, shall be brought to the immediate attention of the Owner for correction or relief of said responsibility. The Contractor is to insure proper drainage of all planting areas at a minimum of 2%.

3.08 SOIL PREPARATION

NOTE: 11.30.07 – BELOW IS A DRAFT SOIL PREPARATION SECTION ONLY - UNTIL TESTING OF VARIOUS LOCATIONS OF EXISTING SOIL AND IRRIGATION WATER CONDITIONS IS TAKEN AT SITE TO DETERMINE IF ANY IMPORT SOIL WILL BE REQUIRED. CONTRACTOR ESTIMATES SHOULD QUALIFY THAT THEIR BIDS “DO” OR “DO NOT” INCLUDE IMPORT TOP SOIL FOR PLANTING.

A. After finish grades for all landscaped areas have been established and approved by the Owner perform the following operations:

B. Cross-rip all area to a depth of 9".

C. Spread organic amendments uniformly on the surface of the soil and cultivate thoroughly into the top 4-6 inches in a minimum of two directions with a mechanical rototiller.

D. The following soil amendments and fertilizers are to be used for bid purposes only. Specific amendment recommendations will be made after horticultural soil samples are taken and paid for by the Contractor and analyzed. Application rates per 1,000 square feet shall be as follows:
- Nitrolized Fir bark - 6 cu. yds.
- Planting fertilizer - 200 lbs. of Gro-Power Plus.
- Agricultural gypsum - 100 lbs.
- Soil sulfur - 20 lbs.

E. After applying soil amendments and prior to planting, irrigate with overhead irrigation so that a minimum of 1-3 inches of good quality water passes through the soil profile.

F. For acid loving plant materials, surface treat planting areas with 2” of peat moss for base bid. This may change after soils recommendations are prepared based upon the required soils testing by the selected contractor.
3.09 BACKFILL MIX FOR SHRUBS AND TREES

A. The following backfill mix is for bid price basis only. Final backfill recommendations will be made only after rough and fine grading operations are completed and horticultural soil testing has been performed and paid for by the Contractor and approved by the Owner.
7 parts by volume on-site soil.
3 parts by volume nitrolized stabilized Fir bark.
2 lbs. iron sulfate per cubic yard of mix.
18 lbs. of Gro-Power Plus per cubic yard of mix.
Planting tablets - quantity based on size of plant.

B. Thoroughly blend the backfill mix prior to placement.

C. Do not apply iron sulfate over paved materials since severe staining is likely to occur.

3.10 TREE PIT PECULATION TESTING

A. Due to the potential of standing water in the tree pits, Contractor is to perform a tree pit percolation test (for trees larger than 15 gallon only) in each tree pit prior to planting the tree. Fill the tree pit to the top with water. If the water has not drained by more than 95% within 24 hours, do not plant the tree and bring this to the immediate attention of the Owner. The Contractor may be required to either dig a substitute plant pit or to install a drainage sump in the existing plant pit. Substitute plant pits are the responsibility of the Contractor under the Base Bid. Drainage sumps are not part of the Base Bid and compensation will be awarded to the Contractor based on the Construction Agreement.

B. Submit written results of each plant pit peculation test with locations, date and time of test to the Owner.

3.11 PLANTING OPERATIONS

A. Planting Layout
1. It is the Contractor's responsibility to verify with the Owner's site superintendent and local governing agencies the location and depth of all underground utilities. If any underground construction or utility lines are encountered in the excavation of planting holes, alternative planting locations may be selected by the Owner.
2. Locations for all shrubs and trees shall be marked on the ground either by flagged grade stakes indicating plant type and size or the actual plants themselves for the Owner’s review and approval prior to planting.

B. General Planting Guidelines
1. Plant only as many plants that can be planted and watered on that same day in a given planting area.
2. Protect the planting area from excessive vehicle compaction.
3. Face plant material with fullest growth into the prevailing wind and/or the primary direction of view.
4. Center plant material in the planting hole.
5. Set plant material plumb and hold rigidly in place until soil has been tamped firmly around the rootball.
6. Planting pits shall have vertical sides and roughened surfaces. The size of the plant pit shall be twice the diameter and only as deep as the rootball itself.

C. Container Removal
1. Plant containers shall be opened and removed in such a manner that the soil surrounding the rootball shall not be broken.
2. Do not injure the root ball while removing the container. After removing plant, superficially cut edge rots with a knife on three (3) sides.

D. Tree Box Removal
1. Remove the bottom of the box before planting.
2. Remove the sides of the box without damaging the rootball after positioning the tree and partially backfilling the plant pit.

E. Shrub and Tree Installation
1. Apply backfill mix to the plant pit up to 1/2 the height of the rootball. Add water to the top of the remaining plant pit and let soak in before completing the remainder of backfilling.

F. Placement of Plant Tablets
1. Prior to planting, place the required amount of planting tablets per plant size on top of each root ball while the plants are still in their containers so that the Owner can easily verify their existence and quantity.
2. After obtaining approval by the Owner on plant tablet quantity and after water has completely drained from the plant pit, add plant tablets to the planting pits in the following quantities:
   - 1 gallon - 3 tablets
   - 5 gallon - 8 tablets
   - 15 gallon - 14 tablets
   - 24" box - 15 tablets
   - 36" box - 19 tablets
   - 48" box - 24 tablets
   - 60" box - 35 tablets
3. Dig planting pit to the recommended depth.
4. Backfill the plant pit to attain the proper level for the plant.
5. Place the specified amount of plant tablets between the bottom of the rootball but not higher than 1/3 of the way up the rootball. Space the plant tablets equally around the perimeter of the rootball approximately 2" from the rootball.
6. Finish backfilling of the planting pit by tamping the soil firmly around the rootball and watering thoroughly.

G. Final Backfilling
1. Once the water has soaked in thoroughly, place the remaining backfill and tamp firmly.
2. After final backfilling, construct an earthen basin around the base of each plant with backfill mix sufficient to hold water for the following plant sizes:
   1 gallon - 2-inches of water.
   5 gallon through 24" box - 3-inches of water.
   36" box and larger - 4-inches of water.
3. Remove basins in all turf areas but not before the irrigation system is operational.

H. Plant Settling
1. Any plant material that has settled deeper than the surrounding grade shall be raised to the correct level.

I. Ground Cover Planting
1. Ground cover flats shall contain sufficient moisture to reduce soil separation when lifting out the plants.
2. Plant ground covers in a straight rows, evenly, triangular spaced, and at an on-center spacing as indicated on the Drawings.
3. Each rooted ground cover plant shall be planted with its proportional amount of soil.
4. Apply a 2-inch layer of wood mulch at the completion of planting.

J. Turf Sod Planting
1. General
   a. Tag all sod indicating botanical and common name of each turf species and submit to the Owner.
   b. Deliver sod on pallets.
   c. Protect root system from exposure to the weather.
   d. Protect sod against dehydration, contamination and heating during transportation and delivery.
   e. Do not deliver more sod than can be installed at the site in one (1) day. Longer periods may be acceptable if the weather is cool and is approved by the Owner.
   f. Keep stored sod moist and under shade.
   g. Do not pile sod more than two (2) feet deep.
   h. Do not tear, stretch or drop sod during placement.

K. Soil Preparation
1. Similar to that stated in "Soil Preparation" above.

L. Fine Grading and Rolling
1. Carefully smooth out all surface irregularities that will be receiving sod. Roll the area to expose soil depressions and regrade as necessary.

M. Fertilizing
1. Spread and rake in lightly, fertilizer onto the soil surface evenly at the rate of (1) pound per 100 square feet of sod area.

N. Watering
1. Water soil to a depth of 4-inches, 48 hours before placing sod.

O. Sod Placement
1. Verify that soil preparation and related preparatory work has been completed prior to placing sod. Do not begin work until conditions are satisfactory.
2. Begin sodding at the bottom of slopes. Peg sod on all slopes greater than 3:1 (33%) with a minimum of (2) stakes per square yard.
3. Lay the first sod strip along a straight baseline. Butt joints tightly but do not overlap the joints. On the second strip, stagger in a running bond pattern. Use a sharp knife to cut the sod to fit irregular curved areas and around irrigation spray heads, valve boxes, etc.

P. Watering
1. Do not lay the entire amount of sod before beginning watering. Water in lightly, when a relatively large area of sod has been placed.

Q. Rolling Sod
1. Roll sod, except on pegged areas, with a lawn roller weighing not more than 150 pounds per foot or roller width.

R. Irrigation
1. Water thoroughly once the sod is installed. The soil should be watered to a minimum depth of 4-inches.

S. Protection
1. Erect temporary barricades and warning signs against vehicular traffic after placing sod.

T. Sod Establishment
1. Keep sod moist during the first week after installation. After the first week, supplement rainfall to produce a total of two (2) inches per day. Repeat watering at regular intervals until the sod establishes itself. Once the sod has become established, decrease the watering frequency and increase the amount of water per application.
2. Mow and maintain turf at a height recommended by the turf nursery. Do not cut more than 40% of the total grass leaf length in one (1) single mowing.
3. Replace all dead or dying sod with new sod.
4. Eradicate weeds between the second and third mowing. Apply herbicides uniformly at the manufacturer's recommended rate.
5. Apply fertilizer uniformly at the manufacturer's recommended rate 30 days after sodding.
6. The sod establishment period is to extend 45 days until the second mowing is complete and approved.
7. Dispose of protective barricades and warning signs at the termination of sod establishment.

U. Container Pot Planting
1. Refer to the Drawings for specific container pot planting layout, waterproofing and sump/drainage details.

3.12 WATERING

A. All planting shall be watered immediately after planting. After the first watering, water shall be applied to all plants as conditions may require to keep the plants in a healthy and vigorous growing condition until the completion of the Contract.

3.13 TREE STAKING

A. Staking of trees shall be completed immediately after planting trees. Trees shall stand plumb before stakes are applied.

B. All stakes shall be installed plumb when tied to the tree. Stakes may be located in a specific location to the trunk - refer to the Drawings.

C. When locating a single stake, locate it on the windward side of the tree and as close to the main trunk as possible without damaging the trunk.

D. Stakes shall be driven at least 3’ into the ground or as specified on the plans.

E. Tie the tree trunk to the stake with the specified tree guy. Cut off stake after installation 4-inches above the upper tie.

3.14 TREE GUYING

A. Guying of trees shall be completed immediately after planting trees. Trees shall stand plumb before guys are applied.

B. Trees shall stand plumb once guys are installed.

C. Guy trees at points of branching with guys spaced 120 degrees apart.

D. Guys shall be covered with black rubber hose at points of contact with bark positioned at crotches and fastened to a deadman. One turnbuckle shall be provided for each guy wire. Use (2) cable clamps at each cable terminus.

E. Install a warning guy wire tube on each guy wire.

3.15 PRUNING

A. At no time shall plant material be pruned, trimmed or topped prior to delivery. Any alteration to their shape shall be conducted only on-site and in the presence of the Owner.
B. All planted material requiring pruning shall be done under the observation of the Owner. Prune planted material only when necessary and under standard horticultural practices to preserve the natural character of the plant.

3.16 WOOD MULCH INSTALLATION

A. Spread a 3” deep layer of mulch in all landscaped areas other than the following:
   1. Turf or Hydroseed areas.

3.17 CLEAN UP

A. Contractor shall remove all trash caused from his Work on a weekly basis throughout the duration of the Project.

B. Upon completion of his Work under this Section, the Contractor shall remove all rubbish, waste and debris resulting from his operations offsite or as directed by the Owner.

C. All scars, ruts or other marks in the ground caused by the Contractors work shall be repaired.

D. Remove all equipment and implements of service, and leave the entire work area in a neat, clean, and Owner-accepted condition. All sidewalks and other paving areas shall receive a broom-clean treatment.

3.18 SITE VISIT SCHEDULE

A. The Contractor shall be responsible for notifying the Owner in advance to schedule the following site visits:
   1. Pre-construction "Kick-Off" meeting - 7 days.
   2. At completion of fine grading - 2 days.
   3. At completion of soil preparation - 2 days.
   4. Delivery of plant material - 2 days.
   5. Plant layout prior to plant pit excavation - 2 days.
   6. At start of tree planting, staking and guying - 2 days.
   7. Final walkthrough prior to going on contracted maintenance period - 7 days.
   8. Final walkthrough for project acceptance - 7 days.

B. The Owner may or may not attend all of the above mentioned site visits. He may also elect to attend more than is listed above, and without notice to the Contractor.

C. When site visits are made by other than the Owner, the Contractor shall show evidence in writing of when and by whom the site visit was made.

D. No site visit will commence without all previous punch list items being completed, unless compliance has been waived by the Owner. Failure to accomplish the timely execution of previous field report punch list items and preparing adequately for the next site visit shall make the Contractor potentially liable for reimbursing the owner's for his
labor and reimbursable expenses. No further site visits will be made until outstanding charges have been paid to the Owner by the Contractor.

END OF SECTION
SECTION 02970

OPERATION AND MAINTENANCE OF PLANTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. After landscape planting and irrigation work have been completed, reviewed and accepted by Owner, furnish materials, labor, transportation, services and equipment necessary to provide landscape maintenance as indicated on Drawings and as specified herein.

B. Work included in this Section:
   1. Continuous maintenance of plant material and irrigation system during specified landscape maintenance period.

C. Work related in other Sections:
   1. Section 02810 – Landscape Irrigation.
   2. Section 02810-A – Landscape Irrigation - Dripline.
   2. Section 02900 – Landscape Planting.

1.02 LANDSCAPE MAINTENANCE PERIOD

A. Landscape Maintenance Period: 90 days from Final Acceptance by Owner. Contractor may, at discretion of Owner, be allowed to proceed into landscape maintenance period if planting and irrigation is deemed "substantially complete" by Owner.

B. Continuously maintain areas involved in this Contract during progress of Work and during landscape maintenance period until Final Acceptance by Owner has been granted.

C. Improper landscape maintenance or possible poor condition of planting at termination of the scheduled landscape maintenance period may cause landscape maintenance period to be continued at no cost to Owner.

D. In order to carry out plant establishment work, furnish sufficient men and adequate equipment to perform Work during landscape maintenance period.

E. Request an observation of Work by Owner to begin landscape maintenance period after planting and related work has been completed in accordance with Contract Documents. A prime requirement is that groundcover and turf areas be planted and show a
consistent and healthy appearance. Mow turf at least two times, no closer than 1 week apart. If such criteria is met to satisfaction of Owner, a field report may be issued to Owner recommending a start date to begin landscape maintenance period.

F. Any day that Contractor fails to adequately perform landscape maintenance, as determined necessary by Owner, that day will not be credited as one of landscape maintenance working days.

G. Prior to being placed on landscape maintenance, submit a schedule of activities planned during landscape maintenance period. This schedule needs to be accepted by Owner prior to start of landscape maintenance. Document scheduled changes and obtain acceptance by Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide materials used during landscape maintenance work in accordance with requirements of Section 02900 - Planting and following:
   1. Shrub and Groundcover Planting Fertilizer:
      a. Consisting of following minimum percents by weight:
         14% Nitrogen
         4% Phosphoric Acid
         9% Potash
         30% Humus
         6% Humic Acid
         3% Sulfur
      b. Acceptable Manufacturers:
         Gro-Power Hi Nitrogen; Gro-Power (909) 393-3744.

B. Submit a list of materials that are to be used during landscape maintenance that are not specified in Section 02900 in written form to Owner for review and approval.

PART 3 - EXECUTION

3.01 LANDSCAPE MAINTENANCE

A. Keep landscape areas free of debris.

B. Keep planted areas weed-free. Cultivate at intervals of not more than 10 days.

C. Maintain adequate protection of Work area. Repair damaged areas.
D. Between 15th day and 20th day of landscape maintenance period, reseed or re-sod spots or areas within turf areas where normal turf growth is not evident. After 20th day, areas that are not acceptable are to be sodded at no cost to Owner.

E. Sweep clean paved areas on once a week intervals or less, if deemed necessary.

3.02 TREE AND SHRUB CARE

A. Watering:
   1. Maintain a large enough water basin around trees and shrubs so that enough water can be applied to establish moisture through major root zone.
   2. When hand watering, use a water wand to break water force.
   3. Replenish wood mulches to reduce evaporation and frequency of watering.
   4. Regulate irrigation watering times to minimize erosion and gullying.

B. Pruning:
   1. Trees:
      a. Prune Trees To:
         1) Select and develop permanent scaffold branches that are smaller in diameter than trunk or branch to which they are attached which have vertical spacing of from 18-inches to 48-inches and radial orientation so as not to overlay one another.
         2) To eliminate diseased or damaged growth.
         3) To eliminate narrow V-shaped branch forks that lack strength.
         4) To reduce toppling and wind damage by thinning out crowns.
         5) To maintain growth within space limitations.
         6) To maintain a natural appearance and to balance crown with root mass.
            a. Under no circumstances, will stripping of lower branches "raising-up" of young trees be permitted.
            b. Retain lower branches in a "tipped-back" or pinched condition with as much foliage as possible to promote caliper trunk growth.
            c. Cut lower branches flush with trunk only after tree is able to stand erect without staking or other support.
            d. Remove sucker growth.
            e. Thin evergreen trees and shape when necessary to prevent wind and storm damage.
      2. Shrubs:
         a. Overall objective of shrub pruning is same as for trees.
         b. Do not clip shrubs into balled or boxed forms unless approved initially by Owner.
         c. Make pruning cuts on lateral branches or buds flush with trunk.
d. Do not “stub” branches.

C. Tree Staking and Guying:
   1. Restake, tighten and repair damaged ties and guys.
   2. Reset to proper grades or upright position, trees that are not in their proper growing position.
   3. Inspect stakes and guys to prevent girdling of trunks or branches and to prevent rubbing that may cause bark wounds.

D. Weed Control:
   1. Keep planted and aggregate areas free of weeds.
   2. Use recommended legally approved herbicides.
   3. Avoid frequent soil cultivation that destroy shallow surface roots.
   4. Replenish lost wood mulch to reduce weed growth.

E. Insect and Disease Control:
   1. Maintain insect and disease control during landscape maintenance period.

F. Fertilization:
   1. Fertilize planting areas with application of Gro-Power Hi-Nitrogen 14-4-9, or equal, commercial fertilizer at the rate of 7 1/2 pounds per 1,000 square feet 30 days after planting.
   2. Repeat fertilizer application at 30 day intervals until end of the landscape maintenance period.

G. Replacement of Plants:
   1. Replace dead, dying and missing plants of a like size and condition as to those that were originally installed at no cost to Owner.

H. Replacement of Soil
   1. Replacement of soil to maintain height of 2” below top of planter.

3.03 GROUND COVER CARE

A. Weed Control:
   1. Control weeds with chemical systemic spray or by hand so as to cause minimal damage to planted materials.

B. Watering:
   1. Water enough so that moisture penetrates throughout root zone and only as frequently as necessary to maintain healthy growth.

C. Fertilizing:

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1. Fertilize as specified under Tree and Shrub care of this Specification.

D. Edge groundcover to keep in bounds and trim top growth as necessary to achieve an overall even appearance.

E. Replace dead, dying and missing plants of a like size and condition as to those that were originally installed.

3.04 TURF CARE

A. Mowing and Edging:
   1. Commence mowing of turf when turf has reached a recommended height for specified species.
   2. Mow weekly after first cut.
   3. Turf must be well established and free of bare spots and weeds prior to Final Acceptance.
   4. Remove excess grass clippings.
   5. Trim paved edges at least twice monthly or as needed for a neat appearance.
   6. Blow or vacuum grass clippings off paved areas.

B. Watering:
   1. Water turf at such frequency as weather conditions require to replenish soil moisture below root zone and maintain healthy turf growth.

C. Fertilizing:
   1. Fertilize turf areas with applications of turf fertilizer on 30 day intervals until end of landscape maintenance period.

D. Weed Control:
   1. If needed, control broadleaf weeds with selective herbicides.

3.05 IRRIGATION SYSTEM

A. Provide maintenance of irrigation system consisting of cleaning and adjusting sprinkler nozzles, repairing damaged equipment, servicing valves, programming controllers and other activities required during landscape maintenance period.

3.06 FINAL WALKTHROUGH

A. At completion of landscape maintenance period, schedule a Final Walkthrough with Owner.
B. Owner, General Contractor and others deemed necessary by Owner may be present at Final Walkthrough.

C. If, during Final Walkthrough Owner is of opinion that landscape maintenance has been substantially completed in accordance with this Section, written notice of recommendation to allow Contractor to be released from Project will be submitted to Owner for approval. This report will note any incomplete punch list items from Final Walkthrough and a date on which these items must be completed. Complete remaining punch list items within 5 working days after Final Walkthrough was performed by Owner.

3.07 CLEANUP

A. Upon completion landscape maintenance, remove rubbish, waste and debris resulting from Contractor's operations.

B. Repair scars, ruts or other marks in landscaped areas caused by Contractor.

C. Remove equipment, implements of service, and leave Work area in a neat and clean condition. Sweep clean paved areas.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials for Portland Cement Concrete.
B. Aggregate and aggregate grading for Portland Cement Concrete.
C. Water for Portland Cement Concrete.
D. Admixtures for Portland Cement Concrete.
E. Proportioning for Portland Cement Concrete.
F. Mixing and transporting Portland Cement Concrete.
G. Formwork for cast in place Portland Cement Concrete.
H. Embedded materials for Portland Cement Concrete.
I. Steel reinforcement for Portland Cement Concrete.
J. Placing and finishing Portland Cement Concrete.
K. Curing Portland Cement Concrete.
L. Protecting Portland Cement Concrete.

1.2 RELATED SECTIONS

A. Section 02300, Earthwork

1.3 RELATED DOCUMENTS

A. ASTM:
   1. A 82, Cold Drawn Steel Wire for Concrete Reinforcement.
   2. A 185, Steel Welded Wire Fabric, Plain for Concrete Reinforcement.
   3. A 615, Deformed and Plain Billet Steel Bars, for Concrete Reinforcement.
7. C 618, Fly Ash and Raw or Calcined Natural Pozzolan for use as Natural Admixture in Portland Cement.

B. Caltrans Standard Specifications:
1. Section 51: Concrete Structures.
2. Section 73: Concrete Curbs and Sidewalks.

1.4 DEFINITIONS

A. ASTM: American Society for Testing Materials

1.5 SUBMITTALS

A. Submittal procedure shall be as outlined in Section 02000.

B. Concrete Mix Design: Have all concrete mixes designed by a testing laboratory and approved by the Consulting Engineer. Conform all mixes to the applicable building code requirement, regardless of other minimum requirements listed herein or on the drawings. Submit mix designs for review before use. Show proportions and specific gravities of cement, fine and coarse aggregate, and water and gradation of combined aggregates.

1.6 QUALITY ASSURANCE

A. Concrete shall be subject to quality assurance in accordance with Section 90 of the Standard Specifications.

1. Slump tests: Have available, at job site, equipment required to perform slump tests. Make one slump test for each cylinder sample, from same concrete batch. Allowable maximum slump shall be 4 inches for walls and 3 inches for slabs on grade.

B. Certifications:

1. Provide Owner’s Representative at the time of delivery with certificates of compliance signed by both Contractor and Supplier containing the following statements:

   a. Materials contained comply with the requirements of the Contract Documents in all respects.
b. Proportions and mixing comply with the design mix approved by the Consulting Engineer. Design mix shall have been field tested in accordance with the herein requirements of the Caltrans Standard Specifications and produces the required compressive strength under like conditions.

c. Statement of type and amount of any admixtures.

2. Provide Owner’s Representative, at time of delivery, with certified delivery ticket stating volume of concrete delivered and time of mixing, or time of load-out in case of transit mixers.

C. Conform to the applicable provisions of Section 51, 73 and 90 of the Caltrans Standard Specification and these Technical Specifications.

1. Conform construction of portland cement concrete surface improvements (including curbs, gutters, medians, valley gutters, walks) to the requirements of Section 73 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Plans.

2. Construct "V" ditches in accordance with Section 72-4 of the Caltrans Standard Specifications; except that finishing shall be in accordance with Caltrans Standard Specification Section 73 instead of 53, or as otherwise required in these Technical Specifications or shown on the Plans.

3. Conform other construction of portland cement concrete items to the requirements of Section 51 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Plans.

1.7 DESIGNATION

A. General: Whenever the 28-day compressive strength is designated herein or on the Plans is a 3,600psi or greater, the concrete shall considered to be designated by compressive strength. The 28-day compressive strength shown herein or on the plans which are less than a 3,600psi are shown for design information only and are not considered a requirement for acceptance of the concrete. Whenever the concrete is designated by class or as minor concrete herein or on the Plans, the concrete shall contain the cement per cubic yard shown in Section 90-1.01 of the Caltrans Standard Specifications.

B. Unless specified otherwise herein or on the Plans, portland cement concrete for this Project shall be Class 2, not less than 590 pounds of portland cement/cubic yard of concrete, as specified in Section 90-1.01 of the Caltrans Standard Specifications.
PART 2 PRODUCTS

2.1 PORTLAND CEMENT

A. General: Type II (modified) cement conforming to section 90-2.01 of the Caltrans Standard Specifications.

B. Provide a coloring equivalent to ¼ pound of lampblack per cubic yard. Add to the concrete at the central mixing plant. Liquiblack, as supplied by Concrete Corporation of Redwood City, California, may be used in lieu of lampblack. One pint of liquiblack shall be considered equal to one pound of lampblack.

2.2 AGGREGATE AND AGGREGATE GRADING

A. General: Conform to the requirements of Section 90-2.02, 2.02A and 2.02B of the Caltrans Standard Specifications.

B. Aggregate Size and Gradation: Conform to the requirements of Section 90-3 of the Caltrans Standard Specifications for 1-inch maximum combined aggregate.

2.3 WATER

A. General: Conform to the requirements of section 90-2.03 of the Caltrans Standard Specifications. For mixing and curing portland cement concrete and for washing aggregates.

2.4 CLASSIFICATION OF PORTLAND CEMENT CONCRETE

A. Class 2: Curbs, gutters, walks, island paving, pipe collars, pipe anchors, thrust blocks, sign and fence footings, and utility structures shall be Class 2 as specified in Section 90-1.01 of the Caltrans Standard Specifications unless otherwise noted on the Plans.

2.5 EXPANSION JOINT MATERIAL

A. Material for expansion joints in portland cement concrete improvements shall be premolded expansion joint fillers conforming to the requirements of ASTM Designation D 1751. Expansion joint material shall be shaped to fit the cross section of the concrete prior to being placed. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site. Unless noted otherwise herein or on the Plans expansion joint thickness shall be as follows:
1. Curbs, Curb Ramps, Island Paving, Sidewalks, Driveways and Gutter Depressions: \(\frac{1}{4}\)-inch.
2. Concrete Slope Protection, Gutter Lining, Ditch Lining and Channel Lining: \(\frac{1}{2}\)-inch.
3. Structures: As indicated.

2.6 REINFORCEMENT AND DOWELS

A. Bar reinforcement for concrete improvements shall be deformed steel bars of the size or sizes called for on the plans conforming to the requirements of ASTM Designation A 615 for Grade 60 bars. Size and shape for bar reinforcement shall conform to the details shown or called for on the Plans. Substitution of wire mesh reinforcement for reinforcing bars will not be allowed.

B. Slip dowels, where noted or called for on the plans or detail drawings shall be smooth billet-steel bars as designated and conforming to the requirements of ASTM Designation A 615 for Grade 60 bars. Ends of bars inserted in new work shall be covered with a cardboard tube sealed with cork; no grease or oil shall be used.

C. Mesh for reinforcement for concrete improvements shall be cold drawn steel wire mesh of the size and spacing called for on the plans conforming to the requirements of ASTM Designation A 82 for the material and ASTM Designation A 185 for the mesh. Size and extent of mesh reinforcement shall conform to the details shown or called for on the plans.

D. Tie wire for reinforcement shall be eighteen (18) gauge or heavier, black, annealed conforming to the requirements of ASTM Designation A 82.

E. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site.

2.7 COLOR AND PATTERN FOR DECORATIVE SURFACES

A. Colors for decorative surfacing shall be CHROMIX admixtures as manufactured by the L. M. Scofield Company, Schedule A-312.05 or approved equal. The specific color shall be as designated or called for on the Plans.

B. Patterns for decorative surfacing shall be standard "Bomanite" patterns as copyrighted by the Bomanite Corporation of Palo Alto, California or equal. The specific pattern shall be as designated or called for on the Plans.
2.8 ACCESSORY MATERIALS

A. Conform water stops and other items required to be embedded in portland cement concrete structures to the applicable requirements of Section 51 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans or detail drawings.

B. Curing Compounds:
1. Regular Portland Cement Concrete: "Non-Pigmented Curing Compound - Chlorinated Rubber Base-Clear" conforming to the requirements contained in Section 90-7.01B, of the Caltrans Standard Specifications.
2. Color Conditioned Decorative Portland Cement Concrete: LITHOCHROME colorwax as manufactured by the L. M. Scofield Company or approved equal.

2.9 FORMS

A. Conform to the requirements of Section 51-1.05 of the Caltrans Standard Specifications.

2.10 PRECAST CONCRETE STRUCTURES

A. Conform to the following Sections of Caltrans Standard Specifications:
1. 51-1.02, Minor Structures.
2. 70-1.02C, Flared End Sections.
3. 70-1.02H, Precast Concrete Structures.

2.11 PORTLAND CEMENT CONCRETE PAVEMENT

A. General: See Section 02751.

PART 3 EXECUTION

3.1 STRUCTURAL EXCAVATION

A. Structural excavation may be either by hand, or by machine and shall be neat to the line and dimension shown or called for on the plans. Excavation shall be sufficient width to provide adequate space for working therein, and comply with CAL-OSHA requirements.

B. Where an excavation has been constructed below the design grade, refill the excavation to the bottom of the excavation grade with approved material and compact in place to 95% of the maximum dry density.
C. Remove surplus excavation material remaining upon completion of the work from the job site, or condition it to optimum moisture content and compact it as fill or backfill on the site, if the material is approved by the Geotechnical Consultant.

3.2 SOIL STERILANT

A. Furnish and apply to areas indicated in accordance with Section 02300.

3.3 BRACING AND SHORING

A. Conform to California and Federal OSHA requirements.

B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the facility being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.

C. Be solely responsible for all bracing and shoring and, if requested by the Owner’s Representative, submit details and calculations to the Owner’s Representative. The Owner’s Representative may forward the submittal to the Geotechnical Consultant, the Consulting Engineer and/or the California Division of Industrial Safety for their review. The Contractor's submittal shall include the basic design, assumed soils conditions and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations related to the proposed facility shall precede a response to the submittal by the Owner’s Representative.

D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the position or operation of the facility being constructed or adjacent utilities and facilities.

3.4 PLACING CONCRETE FORMS

A. Form concrete improvements with a smooth and true upper edge. Side of the form with a smooth finish shall be placed next to concrete. Construct forms rigid enough to withstand the pressure of the fresh concrete to be placed without any distortion.

B. Thoroughly clean all forms prior to placement and coat forms with an approved form oil in sufficient quantity to prevent adherence of concrete prior to placing concrete.

C. Carefully set forms to the alignment and grade established and conform to the required dimensions. Rigidly hold forms in place by stakes set at satisfactory
intervals. Provide sufficient clamps, spreaders and braces to insure the rigidity of the forms.

D. Provide forms for back and face of curbs, lip of gutters and edge of walks, valley gutters or other surface slabs that are equal to the full depth of the concrete as shown, noted or called for on the Plans. On curves and curb returns provide composite forms made from benders or thin planks of sufficient ply to ensure rigidity of the form.

3.5 PLACING STEEL REINFORCEMENT

A. Bars shall be free of mortar, oil, dirt, excessive mill scale and scabby rust and other coatings of any character that would destroy or reduce the bond. All bending shall be done cold, to the shapes shown on the plans. The length of lapped splices shall be as follows:
   1. Reinforcing bars No. 8, or smaller, shall be lapped at least 45 bar diameters of the smaller bar joined, and reinforced bars Nos. 9, 10, and 11 shall be lapped at least 60 bar diameters of the smaller bars joined, except when otherwise shown on the plans.
   2. Splice locations shall be made as indicated on the plans.

B. Accurately place reinforcement as shown on the plans and hold firmly and securely in position by wiring at intersections and splices, and by providing precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads. Provide supports and ties of such strength and density to permit walking on reinforcing without undue displacement.

C. Place reinforcing to provide the following minimum concrete cover:
   1. Surfaces exposed to water: 4-inches.
   2. Surfaces poured against earth: 3-inches.
   3. Formed surfaces exposed to earth or weather: 2-inches.
   4. Slabs, walls, not exposed to weather or earth: 1-inch.

D. Minimum spacing, center of parallel bars shall be two and one half (2-1/2) times the diameter of the larger sized bar. Accurately tie reinforcing securely in place prior to pouring concrete. Placing of dowels or other reinforcing in the wet concrete is not permitted.

3.6 MIXING AND TRANSPORTING PORTLAND CEMENT CONCRETE

A. Transit mix concrete in accordance with the requirements of ASTM Designation C 94. Transit mix for not less than ten (10) minutes total, not less than three (3) minutes of which shall be on the site just prior to pouring. Mix continuous with no
interruptions from the time the truck is filled until the time it is emptied. Place concrete within one hour of the time water is first added unless authorized otherwise by the Owner’s Representative.

B. Do not hand mix concrete for use in concrete structures

3.7 PLACING PORTLAND CEMENT CONCRETE

A. Thoroughly wet subgrade when concrete is placed directly on soil. Remove all standing water prior to placing concrete.

B. Do not place concrete until the subgrade and the forms have been approved.

C. Convey concrete from mixer to final location as rapidly as possible by methods that prevent separation of the ingredients. Deposit concrete as nearly as possible in final position to avoid re-handling.

D. Place and solidify concrete in forms without segregation by means of mechanical vibration or by other means as approved by the Owner’s Representative. Continue vibration until the material is sufficiently consolidated and absent of all voids without causing segregation of material. The use of vibrators for extensive shifting of fresh concrete will not be permitted.

E. Concrete in certain locations may be pumped into place upon prior approval by the Owner’s Representative. When this procedure requires redesign of the mix, such redesign shall be submitted for approval in the same manner as herein specified for approval of design mixes.

3.8 PLACING ACCESSORY MATERIALS

A. Place water stops and other items required to be embedded in of portland cement concrete structures at locations shown or required in accordance with Section 51 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans.

B. Curing Compounds:
   1. Regular Portland Cement Concrete: Apply "Non-Pigmented Curing Compound - chlorinated Rubber Base-Clear" in accordance with Section 90-7.01B, 7.01D and 7.03 of the Caltrans Standard Specifications.
   2. Color Conditioned Decorative Portland Cement Concrete: Apply LITHOCHROME colorwax in accordance with the manufactures instructions.
3.9 EXPANSION JOINTS

A. Construct expansion joints incorporating premolded joint fillers at twenty (20) foot intervals in all concrete curbs, gutters, sidewalks, median/island paving, valley gutters, driveway approaches and at the ends of all returns. At each expansion joint install one-half inch by twelve inch (1/2" x 12") smooth slip dowels in the positions shown or noted on the detail drawings.

B. Orient slip dowels at right angles to the expansion joint and hold firmly in place during the construction process by means of appropriate chairs.

3.10 WEAKENED PLANE JOINTS

A. Construct weakened plane joints in concrete curbs, gutters, sidewalks, median/island paving and valley gutters between expansion joints at ten (10) foot intervals throughout, or as otherwise indicated. Depth of joint score depth to be one-fourth (25%) the thickness of the concrete.

1. Grooved Joints: Form weakened plane joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8-inch. Repeat grooving of weakened plane joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.11 FORM REMOVAL

A. Remove forms without damage to the concrete. Remove all shores and braces below the ground surface, before backfilling.

B. Do not backfill against concrete until the concrete has developed sufficient strength to prevent damage.

C. Leave forms for cast-in-place walls in place at least 72 hours after pouring.

D. Leave edge forms in place at least 24 hours after pouring.

3.12 CONSTRUCTION

A. Form, place and finish concrete curbs, walkways, island paving, valley gutters and driveway approaches in conformance with the applicable requirements of Section 73-1.04, 73-1.05, 72-1.05A and 73-1.06 of the Caltrans Standard Specifications as modified herein.

B. Provide a medium broom finish to all horizontal surfaces unless otherwise shown.
C. Construct new concrete curb, curb and gutter and valley gutters against existing asphalt concrete by removing a minimum of 12-inches of the asphalt concrete to allow placement of curb or gutter forms. Patch pavement with a 6-inch deep lift of asphalt concrete after gutter form is removed.

D. Where monolithic curb, gutter and sidewalk is specified, separate concrete pours will not be allowed.

3.13 CONNECTING TO EXISTING CONCRETE IMPROVEMENTS
A. New curb, gutter, or sidewalk is to connect to existing improvements to remain by saw cutting to existing sound concrete at the nearest score line, expansion joint or control joint. Drill and insert $\frac{1}{2}$-inch diameter by 12-inch long dowels at 24-inches on center into existing improvements. Install pre-molded expansion joint filler at the matching joint.

B. A cold joint to the existing curb is not acceptable.

3.14 DECORATIVE AND NON-DECORATIVE SURFACING CONSTRUCTION
A. Decorative surfacing concrete walks, concrete median islands or other installations shall be formed and placed as a concrete slab conforming to the details shown or noted on the Plans.

B. Add lampblock or equivalent to the non-decorative surface concrete at the central mixing plant.

3.15 FIELD QUALITY CONTROL
A. Finish subgrade for concrete improvements shall be subject to approval prior to placement of forms.

B. No concrete shall be placed prior to approval of forms.

C. Concrete improvements constructed shall not contain "bird baths" or pond water and shall be smooth and ridge free.

D. Conform the finish grade at top of curb, flow line of gutter, and the finish cross section of concrete improvements to the design grades and cross sections.
E. Variation of concrete improvements from design grade and cross section as shown or
called for on the plans shall not exceed the tolerances established in Sections 73-1.05
and/or 73-1.06 of the Caltrans Standard Specifications.

3.16 RESTORATION OF EXISTING IMPROVEMENTS

A. Replace in kind all pavement or other improvements removed or damaged due to the
installation of concrete improvements.

B. Remove, landscaping or plantings damaged or disturbed due to the installation of
concrete improvements. Replace in kind.

END OF SECTION
SECTION 15486
FUEL PIPING SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

A. Furnish and Install:
   1. Natural gas piping, above and below ground.
   2. Valves and specialties.
   3. Pressure reducing valves inside building.
   4. Outdoor Pressure regulators.
   5. Submeters.

B. Gas Service and Meter: The gas meter and natural gas piping upstream of meter will be provided by the Gas Utility Company. The meter will be provided by the Gas Utility Company. The natural gas piping, aboveground and belowground, will be provided by the contractor per this specification.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working – Pressure Ratings:
   1. Piping and Valves: 100 psig minimum, unless otherwise indicated.
   2. Pressure reducing valves: twice the working pressure.
   3. Pressure regulating valves: 65 psig minimum, unless otherwise indicated.
   4. Submeters: twice the working pressure.

1.4 SUBMITTALS

A. Manufacturer's Product Data: Submit for:
   1. Polyethylene plastic pipe (PE pipe) and fittings.
   2. Pressure reducing valves.
   3. Pressure regulating valves.
   4. Emergency gas shut-off valves and relays.

B. Valves and fittings shall be AGA approved.

1.5 QUALITY ASSURANCE

A. Comply with requirements of utility supplying natural gas and with authorities having jurisdiction for natural gas systems.
B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX. For heat fusion joints in PE piping, qualify processes and operators with specific pipe manufacturer’s requirements.

C. Comply with NFPA 54 or AGA IFGC for materials, installation, testing, inspection, and purging.

D. Comply with manufacturer’s instructions for PE pipe installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store PE pipes and valves protected from direct sunlight.

1.7 INTERRUPTION OF EXISTING NATURAL GAS SERVICE

A. System is new. Not applicable.

1.8 COORDINATION

A. Coordinate below ground natural gas piping with utility work.

B. Coordinate above ground natural gas piping with other trades.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING

A. Above Ground (Steel Pipe):
   1. Two Inch and Smaller:
   2. Over Two Inch:
      c. Joints for connection regulators, submeters, and valves with threaded connections, size 2-1/2” to 4” may be threaded.

B. Below Ground (PE pipe):
   1. PE Pipe (polyethylene plastic):
      b. Fittings: ASME D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, PE pipe.

C. Transition Fittings (PE pipe to steel):
   1. Manufactured pipe fitting with one PE pipe end for heat fusion connection to PE pipe and with one ASTM A 53/ A 53M, Schedule 40, steel pipe end for threaded or welded connection to steel pipe.
D. Submeter Service-Line Risers (PE pipe):
1. Manufactured PE pipe fitting with PE pipe end for heat fusion connection to underground PE pipe; PE pipe riser section with protective-coated, anodeless, steel casing and threaded outlet for threaded connection to aboveground steel piping.

2.2 SHUTOFF VALVES

A. Shutoff Valves, General: Manual operation, suitable for natural gas service, and with 100 psig minimum working pressure rating.

B. Nonlubricated, Tapered Plug Valves: Brass or cast iron body, with brass tapered plug; lever operation; and complying with ASME B16.33, MSS SP-78, UL 842. Include lockable lever.

C. Lubricated, Tapered Plug Valves: Cast iron body, with lubricated, brass tapered plug; lever operation; and complying with ASME B16.33, MSS SP-78, UL 842. Include lockable lever.

D. Ball Valves: Bronze body, with chrome plated brass ball; lever handle; and complying with ASME B16.33, MSS SP-110, UL 842. Include lockable lever.

E. Lubricated Plug Valves: Cast iron body, with lubricated, tapered, or cylindrical plug; lever operation; and complying with ASME B16.38, MSS SP-78, UL 842. Include lockable lever.

F. Nonlubricated Plug Valves: Cast iron body with resilient-coated eccentric plug; lever operation; and complying with ASME B16.38, MSS SP-108, UL 842. Include lockable lever.

G. PE Valves: Made for gas distribution, with nut or flat head for key operation; and complying with ASME B16.40, UL 842.

H. Valve Boxes: Cast iron, two section box. Include top section with cover with “GAS” lettering, bottom section with base to fit over valve and barrel 5 inches in diameter, and adjustable cast iron extension of length required for depth of bury. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and with stem of length required to operate valve.

2.3 PRESSURE REDUCING VALVES:

A. Size of gas distribution piping system is based on a gas supply pressure of 5 psig. Provide gas fired equipment with gas pressure regulators of size and capacity required to reduce gas pressure to proper operating pressure.

2.4 PRESSURE REGULATING VALVES

A. Description: Natural gas service regulator complying with ANSI B109.4 or DIR 006.3, listed for service regulators.

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2. Pipe connections:
   a. Two inch and smaller: Threaded.
   b. Over two inch: Flanged.

2.5 EARTHQUAKE VALVES

   1. Construction: Aluminum body, with soft seat construction for positive sealing.
   2. Gravity-assisted spring for shut-off mechanism. Include manual reset cam and visual status window.

2.6 SUBMETERS

A. Sub-Meters, General: Positive displacement gas meter.
   1. Construction: Metal case with temperature compensation, and corrosion resistant internal components.
   2. Pipe connections:
      a. Two inch and smaller: Threaded.
      b. Over two inch: Flanged.

B. Small Capacity Sub-Meters: ANSI B109.1, diaphragm type, with registration in cubic feet for meters with capacities of 500 cfm and less.

C. Large Capacity Sub-Meters: ANSI B109.2, diaphragm type, with registration in cubic feet for meters with capacities of more than 500 cfm.

D. Rotary Sub-Meters: ANSI B109.3, rotating lobe type, with registration in cubic feet.

E. Sub-Meter Bars: Malleable or cast iron frame for supporting service meter. Include offset swivel pipes, nuts with O-ring seal, factory-installed or field-installed dielectric unions, and threaded ends. Omit offset swivel pipes if dimensions match meter connections.

F. Sub-Meter, Bypass Fitting: Ferrous, tee pipe fitting with integral ball check valve and capped side inlet for temporary natural gas supply.

2.7 CONCRETE BASES

A. Description: Precast concrete made of 3000 psi minimum, 28 day compressive strength reinforced concrete; at least 4 inches thick and 4 inches larger in each dimension than supported item, unless otherwise indicated.
PART 3 EXECUTION

3.1 EARTHWORK FOR UNDERGROUND PIPE

A. Refer to Division 2 Section 02310 “Utility Trenching and Backfill” for excavating, trenching, and backfilling.

3.2 ABOVE GROUND PIPING INSTALLATION

A. Remove cutting and threading burrs before assembling piping.

B. Do not install defective piping or fittings.

C. Do not use pipe with threads which are chipped, stripped or damaged.

D. Use teflon tape on male pipe threads.

E. Drips and Sediment Traps: Install drips at points where condensate may collect, including submeter outlets and inlets to equipment. Locate where accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drop to remove plug or cap.

F. Terminate pressure regulator horizontal vents or horizontal vent piping with reducing elbow fittings with large end as outlet. Install fitting outlet turned down with corrosion resistant insect screen in outlet.

G. Install metal shutoff valves on aboveground, natural gas piping.

3.3 BELOW GROUND PIPING INSTALLATION

A. Install underground, natural gas distribution piping buried at least 36 inches below finished grade except where coordinated and approved in advance by the engineer of record.

B. Install underground, PE, natural gas piping according to ASTM D 2774.

C. Install underground, PE, natural gas piping at entrance to and under part of building in steel piping protective conduit that is vented outside.

D. Drips and Sediment Traps: Install drips at points where condensate may collect. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.

E. Terminate pressure regulator horizontal vents or horizontal vent piping with reducing elbow fittings with large end as outlet. Install fitting outlet turned down with corrosion resistant insect screen in outlet.
F. Install PE shutoff valves at branch lines from underground piping main and where shown on the drawings. Install valves with valve boxes.

3.4 SUBMETER AND PRESSURE REGULATOR ASSEMBLY INSTALLATION

A. Install submeter assemblies aboveground, above concrete slabs or concrete bases.
B. Install metal shutoff valves upstream from pressure regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
C. Install pressure regulators with vent outlet horizontal or facing down. Install screen in outlet if not integral with pressure regulator.
D. Install metal shutoff valves upstream from submeters. Install dielectric fittings downstream from submeters.
E. Install submeters downstream of pressure regulators.
F. Install pressure relief or pressure limiting devices so they can be readily operated to determine if devices are free of debris, tested to determine pressure at which they will operate, and examined for leakage if closed.
G. Install at least two pipe bollards in front of meter assemblies. Refer to Division 5 Section “Metal Fabrications: for pipe bollards. Bollards may be omitted if not available to car or truck traffic.
H. Vent all pressure regulating valves directly to the exterior of the building.
I. Do not reduce vent size of regulator or install valves in vent piping.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install unions, in piping two inches and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
C. Install flanges, in piping over two inches, adjacent to flanged valves and at final connection to each piece of equipment having a flanged pipe connection.
D. Connect to utility gas meter according to utility’s procedures and requirements.
E. Install aboveground, natural gas piping upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.
F. Do not use natural gas piping as grounding electrode.
3.6 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic laminate equipment nameplates and signs on or near each pressure regulator and submeter. c.
   1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

B. Refer to Division 15 Section “Mechanical Identification” for equipment nameplates and signs.

C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape over belowground natural gas piping during backfilling of trenches for piping. Install 3” wide warning tape 12” below grade directly over buried pipe. Tape to be labeled “Buried PE Pipe”.

D. Tracer Wire: Install a No. 10 gage copper tracer wire with buried PE pipe to facilitate location with an electronic detector. It is routed to the surface at both ends of the run so that the wire can be energized when the line is being traced. Install tracer wire 8 to 12 inches above pipeline and terminate 3 to 4 inches above grade. Do not wrap wire around pipe.

E. Refer to Division 2 Section 02310 “Utility Trenching and Backfill” for warning tapes.

3.7 PAINTING

A. Paint outdoor, aboveground metal piping, valves, pressure regulators, submeters, meter bars, and piping specialties except units with factory applied paint of protective coating.

B. Damage and Touchup: Repair marred and damaged factory applied finishes with materials and by procedures to match original factory finish.

3.8 TEST

A. After rough-in or prior to initial operation, test and purge fuel gas piping in accordance with Uniform Plumbing Code. Complete successful test and obtain approval before backfill of pipe.
   1. Test at 1-1/2 times working pressure with a minimum test pressure of 60 psig.
   2. Repair or replace piping as required to eliminate leaks, and re-test.
   4. Verify correct pressure settings for service regulators.

B. After equipment installation, test all piping and valves up to gas regulator with a "U" tube manometer at 10 PSIG.

END OF SECTION
SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. This section specifies the basic requirements for the electrical installations and includes requirements common to more than one section of Division 16. In addition, this section and Division 16 specifications apply to the raceway systems for the low voltage structural cable plant. It expands and supplements the requirements specified in sections of Division 1.

B. Standards of the organizations listed below but referred to in the various sections by basic designation only, form a part of this specification to the extent indicated by the reference thereto:
   4. Illuminating Engineering Society (IES).
   5. Institute of Electrical and Electronics Engineers (IEEE).
   6. Insulated Cable Engineers Association ICEA).
   7. National Electrical Manufacturer's Association (NEMA).
  10. Factory Mutual (FM).
  13. ANSI TIA/EIA Telecommunication Building Wiring Standards.

C. References shall mean to the latest edition of the standard.

D. Conform to local ordinances and codes.
1.3 QUALITY ASSURANCE

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Contractor shall coordinate with the appropriate supplier, vendor, or subcontractor regarding the exact and specific rough-in requirements for equipment actually supplied.

B. Conduits, junction boxes, wireway, etc. required for low voltage/telecommunications, cabling shall be coordinated with telecommunications cabling Contractor prior to rough-in.

1.4 ELECTRICAL INSTALLATIONS

A. Coordinate electrical equipment and materials installation with other building components.

B. Verify all dimensions by field measurement. Do not scale drawings.

C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior closing-in the building.

F. Coordinate the access panel requirements with General Contractor to accommodate the installation of electrical equipment and materials.

G. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.

H. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

I. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.

J. Contractor shall review Mechanical, Structural, Low Voltage System and Architectural drawings prior to bid.
K. Final connections to equipment shall be per manufacturer’s approved wiring diagrams, details and instructions. It shall be the Contractor's responsibility to provide materials and equipment compatible with equipment actually supplied.

L. It is the intent of these drawings and specifications to establish a standard of quality.

M. Contractor shall verify and coordinate exact location of equipment to be furnished by others prior to rough-in.

N. Contractor shall be responsible for replacing equipment which is damaged due to incorrect field wiring provided under this section or factory wiring in equipment provided under this division.

O. Wire termination provisions for panelboards, circuit breakers, safety switches and all other electrical apparatus shall be listed as suitable for 75 degree C.

P. Systems shall be complete, operable and ready for continuous operations. Lights, switches, receptacles, motors, etc., shall be connected and operable.

Q. Maintain separation between telecommunication conduits and electrical feeders, electronic ballasts, transformers, etc. to minimize electromagnetic compatibility issues.

R. Contractor shall not exceed two (2) 90 degree elbows in telecommunications conduit runs. If more than two (2) 90 degree turns are required, pullboxes shall be provided for every 180 degrees of bend.

1.5 ELECTRICAL SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 1 Section: SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for submittal definitions, requirements, and procedures.

B. Data shall be submitted in three ring binders and indexed as scheduled below.

1. 16111 - Conduit & Fittings
2. 16120 - Wire & Cable
3. 16121 – Medium Voltage Cable
4. 16141 - Wiring Devices
5. 16160 - Cabinets & Enclosures
6. 16311 - Unit Substation
7. 16321 - Pad Mounted Distribution Transformers
8. 16322 - Unit Substation Transformers
9. 16347 - Medium Voltage Metal-Enclosed Switchgear
10. 16425 - Switchboards
11. 16440 - Disconnect Switches
12. 16461 - Dry Type Transformers
13. 16470 - Panelboards
14. 16480 - Motor Control
15. 16485 - Contactors
16. 16510 - Lighting Fixtures
17. 16600 - Paralleling Switchgear
18. 16610 - Static Uninterrupted Power Supply
19. 16622 - Packaged Engine Generator Systems
20. 16721 - Fire Alarm System
21. 16800 - Preventor Lightning Protection
22. 16900 – Electrical Monitoring and Control System
23. 16901 – Microprocessor Metering Equipment

C. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories.

D. Identify products requiring color selections.

E. Identify products for use on project.

1.6 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated equipment, indicating, manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

1.7 RECORD DOCUMENTS

A. Refer to the Division 1 Section: "CONTRACT CLOSEOUT" for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions; Change Orders; Addendums and equipment and materials used.

1.8 OPERATION AND MAINTENANCE DATA

A. Refer to Division 1 Section: "CONTRACT CLOSEOUT" for procedures and requirements for preparation and submittal of maintenance manuals.

B. In addition to the information required by Division 1 for Maintenance Data, include the following information in English.
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data tests, and complete nomenclature and commercial numbers of all replaceable parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down and emergency instructions and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting, disassembly, repair and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

C. Contractor installed labels/equipment marking and instruction shall be in English.

1.9 WARRANTIES

A. Refer to the Division 1 Section: WARRANTIES and BONDS for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Compile and assemble the warranties specified in Division 16, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty; duration of warranty; and names, addresses and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.13 CLEANING

A. Refer to the Division 1 Section: "CONTRACT CLOSEOUT" or "CLEANING" for general requirements for final cleaning.

END OF SECTION
SECTION 16111
CONDUIT

PART 1 GENERAL

1.1 SUMMARY

A. Rigid metal conduit and fittings.
B. Intermediate metal conduit and fittings.
C. Electrical metallic tubing and fittings.
D. Liquidtight flexible metal conduit and fittings.
E. Non-metallic conduit and fittings.

1.2 RELATED WORK

A. Section 02310 - Trenching: Excavation and backfill for conduit and utilities on site.

1.3 SUBMITTALS

A. Include product data for conduit and conduit fittings.

1.4 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.
C. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
D. FS WW-C-563 - Electrical Metallic Tubing.
E. FS WW-C-566 - Specification for Flexible Metal Conduit.
G. NEMA RN 1 - PVC Externally-Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
PART 2 PRODUCTS

2.1 RIGID METAL CONDUIT AND FITTINGS

A. Rigid Steel Conduit: ANSI C80.1. FS WW-C-581.

B. PVC Externally Coated Conduit: NEMA RN 1; rigid steel conduit with external 20 mil (0.05 mm) PVC coating and internal galvanized surface.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.

2.2 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

A. Conduit: Galvanized steel.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; use fittings and conduit bodies specified above for rigid steel conduit.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. EMT: ANSI C80.3., FS WW-C-563. galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; shall be die-cast or steel set screw type.

2.4 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

A. Conduit: Flexible metal conduit with PVC jacket.


2.5 PLASTIC CONDUIT AND FITTINGS

A. Conduit: NEMA TC 2; Schedule 40 PVC.

B. Fittings and Conduit Bodies: NEMA TC 3.

2.6 CONDUIT SUPPORTS

A. Conduit Clamps, Straps, and Supports: Steel.
PART 3 EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. Size conduit for conductor type specified, 3/4 inch (19 mm) minimum size when installed below grade or in slab on grade.

B. Arrange conduit to maintain headroom and present a neat appearance.

C. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.

D. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

E. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

3.2 CONDUIT INSTALLATION

A. Cut conduit square using a saw or pipe cutter; de-burr cut ends.

B. Bring conduit to the shoulder of fittings and couplings and fasten securely.

C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Install no more than the equivalent of four 90-degree bends between boxes.

E. Use conduit bodies to make sharp changes in direction, as around beams.

F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size.

G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

I. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.
J. Install expansion joints where conduit crosses building expansion or seismic joints.

K. Wipe plastic conduit clean and dry before joining.

L. Use long radius sweeps, twelve times the diameter, for conduits used for telephone, computer, communications, and television larger than 1" in diameter.

3.3 CONDUIT INSTALLATION SCHEDULE


END OF SECTION
SECTION 16120
WIRE AND CABLE

PART 1 GENERAL

1.1 WIRE AND CABLE
A. Building wire.
B. Cable.
C. Metal-clad cable.
D. Wiring connections and terminations.

1.2 REFERENCES
A. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.3 SUBMITTALS
A. Submit manufacturer's instructions for splicing and terminating aluminum conductors.

PART 2 PRODUCTS

2.1 BUILDING WIRE
A. Thermoplastic-insulated Building Wire: NEMA WC 5.
B. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THHN/THWN, or XHHW.
C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN, 8 AWG and larger, stranded conductor; smaller than 8 AWG, solid conductor.
D. Control Circuits: Copper, stranded conductor 600 volt insulation, THW or THHN/THWN.
E. Medium Voltage Cable: Refer to Section 16121.
2.2 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 75 degree C, individual conductors twisted together and covered with a PVC jacket.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together, and covered with a PVC jacket; UL listed.

PART 3 EXECUTION

3.1 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet (23 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

C. Provide conductor cable supports per NEC requirements.

D. Splice only in junction or outlet boxes.

E. Neatly train and lace wiring inside boxes, equipment, and panelboards.

F. Conductor lengths for parallel circuits shall be equal.

3.2 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricate for pulling 4 AWG and larger wires.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

3.3 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible junction boxes.
B. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

C. Use split bolt connectors for copper wire splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.

D. Thoroughly clean conductor before installing lugs and connectors.

E. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

3.4 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

E. Inspect exposed cable sections for physical damage.

F. Inspect cable for proper connections.

G. Verify correct phase rotation and cable identification prior to energizing.

END OF SECTION
SECTION 16121

MEDIUM - VOLTAGE CABLE

PART 1   GENERAL

1.1 SUMMARY

A. Section includes medium voltage cable and cable terminations.

1.2 REFERENCES


B. IEEE 48 (Institute of Electrical and Electronics Engineers) – Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.

C. NEMA WC 3 (National Electrical Manufacturers Association) - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

D. NEMA WC 5 (National Electrical Manufacturers Association) - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

E. NEMA WC 7 (National Electrical Manufacturers Association) - Cross-Linked-Thermosetting-Polyethylene- Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

F. NEMA WC 8 (National Electrical Manufacturers Association) - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.


1.3 SUBMITTALS

A. Product Data: Submit for cable, terminations, and accessories.

B. Test Reports: Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.
1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual sizes and locations of cables.

B. Operation and Maintenance Data: Submit instructions for testing and cleaning cable and accessories.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cable ends from entrance of moisture.

PART 2 PRODUCTS

2.1 MEDIUM VOLTAGE CABLE

A. Manufacturers:
   1. Diamond Wire & Cable Co.
   2. Essex Group Inc.
   3. General Cable Co.
   4. Rome Cable Co.

B. Product Description: NEMA WC 8, ethylene propylene rubber insulated cable.

C. Voltage: 15 kV, ungrounded.

D. Conductor: Copper stranded, with foil conductor shield.

E. Construction: Single conductor with metal tape insulation shielding.

F. Jacket: PVC

2.2 CABLE TERMINATIONS

A. Manufacturers:
   1. RTE Cooper Systems.
   2. 3M.
   3. Elastimold.
B. **Product Description:** IEEE 48, Class 2 porcelain insulator cable terminator in kit form.

### 2.3 CAST-EPOXY CABLE TERMINATION

A. **Manufacturers:**
   1. RTE Cooper Systems.
   2. Elastimold.
   3. 3M.

B. **Product Description:** IEEE 48, Class 1 cast epoxy cable termination in kit form with stress cone, shield ground connection, wet porcelain rain shield for outdoor units, epoxy resin molding material, and accessories and molds required for proper application.

### 2.4 MODULAR CABLE TERMINATION

A. **Manufacturers:**
   1. RTE Cooper Systems.
   2. Elastimold.
   3. 3M.

B. **Product Description:** IEEE 48, Class 1, molded-rubber cable termination in kit form with stress cone, ground clamp, non-tracking rubber skirts, connector, rubber cap, and aerial lug.

### 2.5 TAPE TERMINATION

A. **Manufacturers:**
   1. RTE Cooper Systems.
   2. Elastimold.
   3. 3M.

B. **Product Description:** IEEE 48; Class 1, tape termination kit with semi-conductive tape, stress control tape, splicing tape, vinyl plastic tape, stress cone, mechanical ground straps, and cable preparation kit.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify conduit, duct, trench and pullboxes are ready to receive cable.

B. Verify routing and termination locations of cable prior to rough-in.
3.2 PREPARATION
   A. Use swab to clean conduits and ducts before pulling cables.

3.3 INSTALLATION
   A. Avoid abrasion and other damage to cables during installation.
   B. Use suitable manufacturer-approved lubricants and pulling equipment.
   C. Sustain cable pulling tensions and bending radii below manufacturer’s recommended limits.
   D. Ground cable shield at each termination and splice.
   E. Arrange cable in pullboxes to avoid interference with duct entrances.
   F. Fireproof cables in pullboxes using fireproofing tape in half-lapped wrapping. Extend fireproofing 1 inch into duct.
   G. Provide # 2AWG bare copper grounding conductor within each conduit containing phase conductors.

3.4 FIELD QUALITY CONTROL
   A. Inspect exposed cable sections for physical damage.
   B. Inspect cable for proper connections as indicated.
   C. Inspect shield grounding, cable supports, and terminations for proper installation.
   D. Inspect and test in accordance with NETA ATS, except Section 4.
   E. Perform inspections and tests listed in NETA ATS, Section 7.3.

3.5 PROTECTION OF INSTALLED CONSTRUCTION
   A. Protect installed cables from entrance of moisture.

END OF SECTION
SECTION 16130

BOXES

PART 1 GENERAL

1.1 SUMMARY

A. Pull and junction boxes.

1.2 REFERENCES

A. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. TIA/EIA 569 – Telecommunications Building Wiring Standards.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Cast Boxes: Cast ferroalloy, deep type, gasketed cover, threaded hubs.

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned.
C. Locate and install to maintain headroom and to present a neat appearance.

3.2 OUTLET BOX INSTALLATION

A. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

B. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.

C. Provide cast outlet boxes or bell boxes in exterior locations exposed to the weather, wet locations and exposed interior locations to 6' feet above finish floor.

3.3 PULL AND JUNCTION BOX INSTALLATION

A. Support pull and junction boxes independent of conduit.

END OF SECTION
SECTION 16321

PAD MOUNTED DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDED

A. Liquid filled pad mounted distribution transformers.

1.2 REFERENCES


B. ANSI C57.12.00 - General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

C. ANSI C57.12.28 - Switchgear and Transformers--Pad-Mounted Equipment--Enclosure Integrity.


H. IEEE 386 - Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.

I. NEMA 260 - Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas.


K. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

A. Shop Drawings: Indicate electrical characteristics and connection requirements, outline dimensions, connection and support points, weight, specified ratings and materials.
B. Product Data: Provide electrical characteristics and connection requirements, standard model design tests, and options.

1.4 SUBMITTALS FOR INFORMATION

A. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

B. Submit manufacturer's installation instructions.

C. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

D. Manufacturer's Field Reports: Indicate activities on site, final adjustments and overcurrent protective device coordination curves, adverse findings, and recommendations.

1.5 PROJECT CLOSEOUT SUBMITTALS

A. Include copy of manufacturer's certified drawings in project record documents.

B. Maintenance Data: Include maintenance instructions for cleaning methods; cleaning materials recommended; procedures for sampling and maintaining fluid.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five (5) years experience.

B. Testing Agency: Company specializing in testing products specified in this section with minimum five (5) years experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

1.8 DELIVERY, STORAGE AND HANDLING

A. Accept transformers on site. Inspect for damage.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.10 MAINTENANCE MATERIALS

A. Contract Closeout under provisions of Division 1 Sections.

B. Furnish two (2) each of any special tools required to operate and maintain transformer.
1.11 EXTRA PRODUCTS

A. Furnish two (2) of each size and type fuse.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cutler Hammer.
B. Sorgel (Square D).
C. General Electric.
D. Acme.
E. Siemens.

2.2 LIQUID-FILLED TRANSFORMERS

A. Liquid-filled Transformers: ANSI C57.12.26, three phase, pad mounted, self-cooled transformer unit.
B. Cooling and Temperature Rise; ANSI C57.12.00; Class OA. 65 degrees C, self-cooled.
C. Insulating Liquid: R-TEMP, less flammable hydrocarbon fluid conforming to IEEE C57.121.

2.3 SERVICE CONDITIONS

A. Meet requirements for usual service conditions described in ANSI C57.12.00, IEEE C57.12.01 and for the specified unusual service conditions.

2.4 RATINGS

A. Capacity: As indicated on drawings.
B. Primary Voltage: As indicated on drawings.
C. Taps: Standard primary taps.
D. Secondary Voltage: As indicated on drawings.
E. Impedance: 5.75 percent maximum.
F. Basic Impulse Level: 95 kV.

2.5 ACCESSORIES

A. Accessories: ANSI C57.12.00, IEEE C57.12.01, standard accessories.
B. Tap Changer: Externally-operated type.
C. Primary Terminations: Bushing wells to IEEE 386; provide three for radial feed. Include bushings for insulated loadbreak connectors.
E. Secondary Terminations: Spade lugs.
F. Other Accessories: Primary lightning arrestors

2.6 FABRICATION
A. Conform to the requirements of ANSI C57.12.28.

2.7 FACTORY FINISHING
A. Clean surfaces before applying paint.
B. Apply corrosion-resisting primer to all surfaces.
C. Apply finish coat of baked enamel paint to 4mm thick.
D. Finish Color: Manufacturer's standard light gray finish.

2.8 SOURCE QUALITY CONTROL
A. Provide testing under provisions of under provisions of Division 1 Sections.
B. Provide factory tests to ANSI C57.12.90, IEEE C57.12.91. Include routine tests as defined in ANSI C57.12.00, IEEE C57.12.01 and the following other tests:
   1. Impedance voltage and load loss.
   2. Dielectric tests.
   3. Audible sound level.
   4. Short circuit capability.
   5. Telephone influence factor (TIF).
   7. Temperature rise.
C. Test insulating liquid samples in accordance with IEEE C57.121.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Coordination and Meetings: Verification of existing conditions prior to beginning work under provisions of Division 1 Sections.
3.2 INSTALLATION

A. Install in accordance with IEEE C57.94.

B. Install plumb and level.

C. Install safety labels to NEMA 260.

3.3 FIELD QUALITY CONTROL

A. Quality Assurance and Starting of Systems: Field inspection, testing, adjusting, and balancing under provisions of Division 1 Sections.

B. Inspection and test in accordance with NETA ATS, except Section 4.

3.4 ADJUSTING

A. Adjust primary taps so that secondary voltage is above and within 2 percent of rated voltage.

END OF SECTION
PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Contractor shall furnish and install the equipment as specified herein and as shown on the contract drawings.

1.2 REFERENCES

A. The medium-voltage metal-enclosed switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows:
   1. ANSI/IEEE C37.20.3
   2. ANSI/IEEE C37.20.4
   3. ANSI C37.22
   4. NEMA SG5
   5. NEMA SG.6
   6. CSA22.2 No. 31-M89 (5/15 kV only)
   7. EEMAC G8-3.3 (5/15 kV only)
   8. NFPA 70
   9. NETA ATS

1.3 SUBMITTALS

A. The following information shall be submitted:
   1. Master drawing index
   2. Front view elevation
   3. Floor plan
   4. Top view
   5. Single line
   6. Schematic diagram
   7. Nameplate schedule
   8. Component list
   9. Conduit entry/exit locations
   10. Assembly ratings including:
       a. Short-circuit rating
       b. Voltage
       c. Continuous current
       d. Basic Impulse level
   11. Major component ratings including:
       a. Voltage
       b. Continuous current
       c. Interrupting ratings
   12. Cable terminal sizes.
B. Where applicable the following additional information shall be submitted:
   1. Busway connection
   2. Connection details between close-coupled assemblies
   3. Composite floor plan of close-coupled assemblies
   4. Key interlock scheme drawing and sequence of operations.

C. The following product information shall be submitted; if available:
   1. Descriptive bulletins
   2. Product data sheets.

D. The following information shall be submitted for record purposes:
   1. Final as-built drawings and information for items listed in section 1.3
   2. Wiring diagrams
   3. Certified production test reports
   4. Installation information including equipment anchorage provisions
   5. Seismic certification.

1.4 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within
the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002
certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a
minimum period of five (5) years. When requested by the Engineer, an acceptable list of
installations with similar equipment shall be provided demonstrating compliance with this
requirement.

D. The switchgear assembly and fusible switches shall be suitable for and certified to meet all
applicable seismic requirements of Uniform Building Code (UBC for zone 4 application.
Guidelines for the installation consistent with these requirements shall be provided by the
switchgear manufacturer and be based upon testing of representative equipment. The test
response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of
0.75g, and a ZPA of 0.38g. The tests shall fully envelope this response spectrum for all
equipment natural frequencies up to at least 35 Hz.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirement of NFPA 70 and IEEE C2.

B. Products: Listed and classified by Underwriter’s Laboratories, Inc. as suitable for the purpose
specified and indicated.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One
(1) copy of these instructions shall be included with the equipment at time of shipment.
B. Each switchgear assembly shall be split into shipping groups for handling as indicated on the
drawings or as the manufacturer's limitations dictate. Shipping groups shall be designed to be
shipped by truck, rail or ship. Shipping groups shall be bolted to skids. Accessories shall be
packaged and shipped separately. Each switchgear shipping group shall be equipped with
lifting eyes for handling solely by crane.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Ten (10) copies of the equipment operation and maintenance manuals shall be provided.

B. Operation and maintenance manuals shall include the following information:
   1. Instruction books and/or instruction leaflets
   2. Recommended renewal parts list
   3. Drawings and information required by section 1.5.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are acceptable:
   2. Siemens.
   3. Square D.

2.2 FUSIBLE LOAD INTERRUPTOR SWITCHGEAR

A. The 15-kV switchgear assembly ratings shall be as follows:
   - Maximum Design Voltage: 15.0 kV
   - Basic Impulse Level: 95 kV
   - Nominal System Voltage: 12.47 kV three-phase three-wire
   - Main Bus Continuous Current Rating: 1200
   - Switch Continuous and Load Break Current Rating: 600
   - Fused Interrupter Switches:
     - Current at Rated Maximum kV: 61 kA Symmetrical
     - Short-Time (2-Second) Current: 38 kA
   - Closing and Latching Capability (and assembly momentary): 40 kA Asymmetrical
2.3 CIRCUIT BREAKERS

A. All circuit breakers shall be horizontal drawout type, with self-aligning line-side and load-side disconnecting devices. Primary disconnecting contacts shall be silver-plated copper.

B. All circuit breakers shall be of equal rating and shall be interchangeable. The circuit breakers shall be rated as follows:
   1. Nominal voltage rating of 15,000 volts with a withstand voltage rating of 19,000 volts and a basic impulse level of 95,000 volts.
   2. Continuous current rating of 1200 amperes elements shall be supplied, as indicated on the drawings and detailed elsewhere in this specification, with a close and latch capability of 37,000 amperes.
   3. Nominal 3 phase symmetrical interrupting capability of 750 MVA with interrupting time not more than 3 cycles.

C. Each circuit breaker shall contain three vacuum interrupters, separately mounted in a self-contained, self-aligning housing which can be removed as a complete unit. The interrupters shall be designed to facilitate the following work:
   1. Replacement of the interrupter assembly through a simple alignment of the primary contacts and adjustment of contact wipe.
   2. Measurement of available contact life by referring to a contact wear gap indicator for each vacuum interrupter, which requires no tools to operate and is easily visible when the breaker is withdrawn on extension rails.

D. The circuit breaker shall be equipped with tinned-plated secondary contacts which automatically engage in the breaker operating position and can be manually engaged in the breaker test position.

E. The breaker shall be operated via a spring-charged, stored energy system with an automatic electric recharging motor. The mechanism shall always store sufficient energy to insure a trip open operation. Trip, close and spring charge control power shall be 125 VDC derived from the 15 kV Critical Power Switchgear Station Battery System.

F. All circuit breakers shall be equipped with the following basic components:
   1. A minimum of four sets (a/b) of breaker auxiliary contacts with the final number required to be determined by the Switchgear Manufacturer.
   2. Trip and close/spring charge control power fuse blocks.
   3. All circuit breakers shall have circuit breaker status annunciator lights as detailed elsewhere in this specification. The circuit breaker annunciator shall be a group of three, individual 1.0” x 1.0” (minimum) back lit LED annunciators with engraved marking plates as follows:
      a. Circuit breaker open.
      b. Circuit breaker closed.
      c. Circuit breaker not available. This status point shall indicate for any of the following: circuit breaker disconnected, protective relay trip, control voltage failure, springs not charged and failure of breaker trip or close circuitry.
2.4 CONSTRUCTION

A. The metal-enclosed switchgear assembly shall consist of dead front, completely metal-enclosed vertical sections each containing a fused load interrupter switch. Where shown, furnish additional vertical sections containing load interrupter switches and fuses or miscellaneous auxiliary apparatus of the number, rating and type noted on the drawings or specified herein.

B. The following features shall be supplied on every vertical section containing a three-pole, two-position open-closed switch and vacuum circuit breaker:
   1. A high-impact viewing window that permits full view of the position of all three switch blades through the closed door.
   2. On vertical sections, the door shall be interlocked with the switch so that:
      a. The switch must be opened before the door can be opened
      b. The door must be closed before the switch can be closed.

C. On vertical sections with a circuit breaker, the enclosure door must be capable of being safely opened by barrier off all high-voltage parts with grounded metal, thus providing full access to the front of the circuit breaker control face plate and all low-voltage control and instrumentation devices.
   1. A grounded metal barrier in front of every switch to prevent inadvertent contact with any live part, yet allow for a full-view inspection on the switch blade position.
   2. Provision for padlocking the switch in the open or closed position.
   3. Permanent OPEN-CLOSED switch position indicators.

D. Vertical section construction shall be of the universal frame type using die formed and bolted parts. All enclosing covers and doors shall be fabricated from steel whose thickness shall be equal to or greater than those specified in ANSI/IEEE C37.20.3. To facilitate installation and maintenance of cables and bus in each vertical section, a removable top cover and (a) removable rear cover(s), a rear door latched closed by tamper resistant padlockable latches shall be provided.

E. Each vertical section containing a switch shall have a single, full length, flanged front door and shall be equipped with two rotary latch type padlockable handles. Provision shall be made for operating the switch and storing the removable handle without opening the full length door. A nameplate shall be mounted on the front door of each vertical section.

2.4 BUS

A. All buses shall be fully insulated copper.

B. A neutral bus shall be provided when indicated on the drawings. It shall be insulated for 1000 volts AC to ground. The current rating of the neutral bus shall be 600 amperes.

2.5 WIRING/TERMINATIONS

A. One terminal pad per phase shall be provided for attaching Contractor supplied cable terminal lugs for a maximum of two conductors per phase of the sizes indicated on the drawings. Sufficient space shall be supplied for Contractor supplied electrical stress relief termination devices.
B. Small wiring, fuse blocks and terminal blocks within the vertical section shall be furnished as indicated on the drawings. Each control wire shall be labeled with wire markers. Terminal blocks shall be provided for customer connections to other apparatus.

2.6 LOAD INTERRUPTER SWITCHES

A. Each load interrupter switch shall have a manual over-toggle type mechanism that does not require the use of a chain or a cable for operation, and utilizes a heavy-duty coil spring to provide opening and closing action. The speed of opening and closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position.

B. The interrupter switch shall have separate main and break contacts to provide maximum endurance for fault close and load interrupting duty.

C. The interrupter switch shall have insulating barriers between each phase and between the outer phases and the enclosure.

D. A maintenance provision shall be provided for slow closing the switch to check switch-blade engagement and slow opening the switch to check operation of the arc interrupting contacts.

E. For fused switch cubicles, fault protection shall be furnished by fuses as shown in the contract documents. The fuses shall have a minimum interrupting rating of 40,000 amperes symmetrical at 15 kV and shall be S&C SM5 expulsion type with three (3) spare fuse refills for each fused switch specified above.

2.7 ACCESSORIES

A. Supply key interlocks as shown on the drawings

B. For switchgear, 12 KV intermediate class surge arresters shall be provided connected at the incoming terminations and securely grounded to the metal structure.

2.8 OUTDOOR ENCLOSURES

A. Each outdoor vertical section shall have a weatherproof roof. All external openings shall be screened to prevent the entrance of small animals and barriered to inhibit the entrance of sand, etc. The design shall be non-walk-in type.

2.9 NAMEPLATES

A. A nameplate shall be mounted on the front door of each switch vertical section in accordance with the drawings.

2.10 FINISH

A. Prior to assembly, all enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically, then fused on by baking in an oven. The

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coating is to have a thickness of not less than 1.5 mils. The finish shall have the following properties:

- Impact resistance (ASTM D-2794): 60 direct/60 indirect
- Pencil hardness (ASTM D-3363): H
- Flexibility (ASTM D-522): Pass 1/8-inch mandrel
- Salt spray (ASTM B117-85 [20]): 600 hours
- Color: ANSI 61 gray

2.12 MISCELLANEOUS DEVICES

A. Motor operators, where indicated on the drawings, shall have the following features:
1. All motor-operated switches shall consist of a standard manually-operated switch in combination with an electric motor driven linear actuator which charges the spring. Connection between the linear actuator and switch mechanism shall be by reliable rigid metal - to - metal linkages; not chains or cables. The linear actuator and all associated low-voltage wiring shall be located in a low-voltage compartment or buried to separate it from the high voltage.
2. Operating voltage shall be 120 volts, 60 Hz available from a fused control transformer. The switch shall be capable of manual operation should loss of control power be encountered.
3. The linear actuator shall be a highly repetitively manufactured item, completely sealed and weather protected, and designed for rugged industrial application. No lubrication or adjustments shall be necessary for its normal operating life. The motor shall be equipped with an automatically reset thermal overload protector.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
1. Circuit breaker operated over the range of minimum to maximum control voltage.
2. Factory setting of contact gap.
3. One (1) minute dielectric test per ANSI standards.
4. Final inspections and quality checks.

B. The following production test shall be performed on the circuit breaker housing:
1. One (1) minute dielectric test per ANSI standards on primary and secondary circuits.
2. Operation of wiring, relays and other devices verified by an operational sequence test.
3. Final inspection and quality check.

C. The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

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3.3 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 1 working day. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide three (3) copies of the manufacturer's field start-up report.

3.4 FIELD ADJUSTMENTS

A. The relays shall be set in the field by: A qualified representative of the manufacturer, retained by the Contractor in accordance with settings designated in a coordination study of the system as required elsewhere in the contract documents.

3.5 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.6 TRAINING

A. The Contractor shall provide a training session for up to 10 Owner's representative(s) for 1 normal workday at a jobsite location determined by the Owner.

B. The training session shall be conducted by a manufacturer's qualified representative and consist of instruction on the assembly of switches, circuit breaker(s), protective devices, and other major components.

END OF SECTION
SECTION 16361
AIR INTERRUPTER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY
A. Medium voltage interrupter switches.
B. Medium voltage fuses.

1.2 REFERENCES
A. IEEE 37.20.3 - Metal-Enclosed Interrupter Switchgear.
B. IEEE 24 - Outdoor Bushings, Part 2; Electrical, Dimensional, and Related Requirements.
C. IEEE 48 - Test Procedures and Requirements for High-Voltage AC Cable Terminations.
F. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW
A. Shop Drawings: Indicate outline dimensions, enclosure construction, shipping splits, lifting and supporting points, electrical single line diagram, and equipment electrical ratings.
B. Product Data: Provide data for components and accessories.

1.4 SUBMITTALS FOR INFORMATION
A. Test Reports: Indicate findings of field quality control procedures.
B. Submit manufacturer's installation instructions.

1.5 PROJECT CLOSEOUT SUBMITTALS
A. Maintenance Data: Fuse replacement, adjustment and lubrication instructions.

1.6 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70 and IEEE C2.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Material and Equipment: Transport, handle, store, and protect products.
B. Protect interrupter switches from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure in accordance with manufacturer's instructions.

1.8 EXTRA MATERIALS
A. Furnish two insulated-handle tools designed for handling medium voltage fuses.
B. Furnish four (4) spare fuses of each size and rating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. The following are acceptable manufacturers:
   1. Cutler Hammer
   2. Square D.
   3. Siemens
   4. General Electric

2.2 AIR INTERRUPTER SWITCHES
A. Description: IEEE C37.20.3, switchgear assembly of individual air interrupter switches in free-standing cubicles, securely bolted together to form an integrated structure, suitable for installation where accessible by authorized personnel only.
B. System Voltage: 12 kV, three phase, 3 wire 60 Hz.
C. Maximum Design Voltage: 15 kV.
D. Basic Impulse Level: 95 kV.
E. Main Bus Ampacity: As indicated on drawings.
F. Short Circuit Rating: As shown on drawings.

2.3 COMPONENTS
A. Interrupter Switch: Fused two position load interrupter switch.
B. Voltage and Short Circuit Ratings: Match ratings specified for integrated assembly.
C. Continuous Rating: 600 amperes.

2.4 ACCESSORIES

A. Surge Arrestors: Distribution class, rated 12 kV; mount in incoming line compartment.

B. Incoming Cable Terminations: Clamp-type. Provide dual lugs for feed thru capability.

C. Operating Handle: Permanently mounted, lockable in both positions, interlocked to prevent opening fuse compartment door with switch in CLOSED position.

2.5 FABRICATION

A. Construction: Weatherproof.

B. Provide sloped drip-proof roof and door in door construction.

C. Include continuous ground bus through switchgear assembly, securely connected to frame of each cubicle.

D. Main Bus: Insulated Aluminum.

2.6 FACTORY FINISHES

A. Clean surfaces before applying paint.

B. Apply corrosion-resisting primer to all surfaces.

C. Apply finish coat of manufacturer's standard baked enamel paint to 4 mils 1 mm thick.

D. Finish Color: Light Gray.

2.7 MEDIUM VOLTAGE FUSES

A. Description: Enclosed current limiting, Expulsion type suitable for use outdoors in enclosure.

B. Fuse Rating: E rated fuse, size as indicated.

C. Voltage: 15 kV.

D. Interrupting Rating: As indicated on drawings.

2.8 SOURCE QUALITY CONTROL

A. Provide factory inspection and testing in accordance with IEEE C37.20.3.

PART 3 - EXECUTION

Air Interrupter Switches
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3.1 INSTALLATION
   A. Install on concrete foundation.

3.2 FIELD QUALITY CONTROL
   A. Quality Assurance: Field inspection, testing, and adjusting under provisions of Division 1 Sections.
   B. Inspect and test in accordance with NETA ATS, except Section 4.
   C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION
SECTION 16461

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY
   A. Dry type two winding transformers.

1.2 RELATED WORK
   A. Section 16950 - Testing.

1.3 REFERENCES
   A. ANSI/NEMA - ST 1 - Specialty Transformers.
   B. ANSI/NEMA ST 20 - Dry Type Transformers for General Applications.

1.4 SUBMITTALS
   A. Submit product data under provisions of Section 01300.
   B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, sound level, insulation system type, and rated temperature rise.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Store and protect products under provisions of Section 01610.
   B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
   C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DRY TYPE TWO WINDING TRANSFORMERS

   A. Any of the following manufacturers may be used in the base bid.
      1. Power Quality International
      2. Cutler Hammer
      3. Square D Co.
      5. Siemens (ITE)
      6. Powersmith
B. Substitutions: Under provisions of Section 01630.

2.2 DRY TYPE TWO WINDING TRANSFORMERS

A. Dry Type Transformers: ANSI/NEMA ST 20; factory-assembled, air cooled dry type transformers; ratings as shown on the Drawings.

B. Insulation system and average winding temperature rise for rated KVA as follows:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Class</th>
<th>Rise (degree C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-15</td>
<td>185</td>
<td>150</td>
</tr>
<tr>
<td>16-500</td>
<td>220</td>
<td>150</td>
</tr>
</tbody>
</table>

C. Case temperature shall not exceed 35 degrees C rise above ambient at its warmest point.

D. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.


F. Sound Levels: ANSI/NEMA TR-27, 26-150KVA: 50 db; 151-300KVA:55 db; 301-500KVA: 60 db.

G. Basic Impulse Level: 10 KV for transformers less than 300 KVA, 30 KV for transformers 300 KVA and larger.

H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

I. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting. Provide rubber in shear sound/vibration isolation pads for all transformers.

J. Coil Conductors: Continuous windings with terminations brazed or welded.

K. Enclosure: ANSI/NEMA ST 20; Type 1 or Type 3R as noted on the Drawings. Provide lifting eyes or brackets.

L. Isolate core and coil from enclosure using vibration-absorbing mounts.

M. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

PART 3 - EXECUTION

Dry Type Transformers
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3.1 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, 2 ft (0.6 m) minimum length, for connections to transformer case.

C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

D. Provide seismic restraints per applicable seismic requirements.

E. Provide trapeze hanger and supports as required for trapeze suspended transformers.

3.2 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION
SECTION 16510
LIGHTING FIXTURES

PART 1- GENERAL

1.1 SUMMARY
A. Interior luminaires and accessories.
B. Exterior luminaires and accessories.
C. Lamps.
D. Ballasts.

1.2 RELATED WORK
A. Section 02225 - Trenching: Excavation and backfill for utilities.
B. Section 09900 - Painting.

1.3 REFERENCES
A. ANSI C82.1 - Specification for Fluorescent Lamp Ballasts.
B. ANSI C82.4 - Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type.)
C. FS W-F-414 - Fixture, Lighting (Fluorescent, Alternating-Current, Pendant Mounting.)
D. NEMA LE 2 - HID Lighting System Noise Criterion (LS-NC) Ratings.

1.4 SUBMITTALS
A. Include outline drawings, lamp and ballast data, support points, weights, colors and accessory information for each luminaire type.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Handle metal poles carefully to prevent breakage and damage to finish.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES
A. Fluorescent Luminaires: FS W-F-414; provide hinged frames with spring latches, and virgin acrylic lenses unless scheduled otherwise on Drawings.

B. Recessed Luminaires: Provide trim type and accessories required for installation in ceiling system installed. Verify trim types specified with ceiling systems indicated on the architectural drawings, note any discrepancies on the shop drawings.

C. Exit Signs: Directional arrows as indicated, universal mounting type as scheduled.

D. HID Luminaires: Pre-wired, with integral ballast.

E. Recessed fixtures shall be thermally protected and U.L. listed.

F. Verify fixture supply voltage with circuit voltage prior to shop drawing submittal, note any discrepancies on the submittal.

2.2 ACCEPTABLE MANUFACTURERS - FIXTURES

A. Any of the following manufacturers may be used in the base bid subject to contract document requirements:
   1. USI
   2. Lithonia
   3. Thomas
   4. Genlyte
   5. Cooper

2.3 EXTERIOR LUMINAIRES AND ACCESSORIES

A. Enclosures: Complete with gaskets to form weatherproof assembly.

B. Provide low temperature ballasts, with reliable starting to 0 degrees F (-17 degrees C.)

2.4 ACCEPTABLE MANUFACTURERS - LAMPS

A. Any of the following manufacturers may be used in the base bid.
   1. General Electric Co.
   3. Sylvania G.T.E.
   4. Venture Lighting
   5. Substitutions: Under provisions of Section 01630.

2.5 LAMPS

A. General Use Incandescent Lamps: Inside frosted type, rated 130 volts.

B. Incandescent Reflector Lamps: Shape as scheduled, rated 130 volts.
C. Fluorescent Lamps: Energy saving type compatible with ballasts provided as scheduled on the drawings.

D. Metal Halide HID Lamps: As scheduled on Drawings.

2.6 ACCEPTABLE MANUFACTURERS - FLUORESCENT BALLASTS

A. Any of the following manufacturers may be used in the base bid.
   1. Advance Transformer Co.
   2. Triad-Ultrad
   3. Motorola

2.7 FLUORESCENT BALLASTS

A. The following ballasts are acceptable:
   1. Advance: #VCN-1P32-TP, VCN-2P32-TP
   2. Triad-Ultrad: #B140R277, B240R277
   3. Approved equivalent.

B. The ballasts shall be thermally protected Class P and UL listed. The ballasts shall have Class A sound rating. The ballasts shall be capable of starting with minimum starting temperature of 50 degrees F. The maximum temperature rise shall not exceed 35 degrees C. in the ballasts. The ballasts shall not contain polychlorinated byphenls (PCB). Ballasts shall be high power factor (minimum 90 percent). Ballasts casing shall have a thermo-setting and 100 percent filler to serve as a conformal coating and protective insulation against both internal and external damage. Ballasts shall be high frequency (20 kHz or greater) and operate without a detectable flicker.

C. The solid state ballasts shall meet American National Standards Institute acceptable performance tolerances. As a minimum, the ballasts shall produce full light output from the luminare when compared to the core-coil ballast. The manufacturer of the solid state electronic ballasts shall furnish certified laboratory data of the ballasts and lamps performance to verify the light output as a combination.

D. The ballasts shall be equipped with surge protection. The ballasts shall be protected for transient surges of 6000 volts. The radio frequency conductive noise shall be limited to the extent that it does not effect computer communication and other electrical equipment, including wireless LAN access points (transmit receive units) and security equipment. The electro-magnetic interference shall comply with Part 18-15J of the Federal Communications Commission.

E. The ballasts shall be capable of receiving power at 120 or 277 volts as specified at 60 Hertz. The light change shall not be more than 15 percent with 10 percent line voltage regulation. The ballast harmonic distortion shall not exceed 5 percent THD.

F. Ballasts shall be marked with manufacturer's name, part number, supply voltage, sound rating, power factory, open circuit voltage, current draw for each lamp type, and UL listing.
G. Maximum number of lamps per ballast shall be two.

2.8 HID BALLASTS

A. HID Ballast: ANSI C82.4; suitable for 122 degrees F (50 degrees C) ambient.

B. LS-NC Rating: NEMA LE 2; equal to or less than ratings listed in Table C-1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lamps in luminaires and lampholders.

3.2 RELAMPING

A. Relamp luminaires which have failed lamps at completion of Work.

3.3 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.

END OF SECTION