CAMPUS MODERNIZATION AT

SOUTH SAN FRANCISCO HIGH SCHOOL

400 B ST, SOUTH SAN FRANCISCO, CA 94080

FOR
SOUTH SAN FRANCISCO HIGH SCHOOL UNIFIED SCHOOL DISTRICT

OUTLINE SPECIFICATIONS AND BASIS OF DESIGN NARRATIVE

SCHEMATIC DESIGN PRICING SET
AUGUST 26, 2026

ARCHITECTURAL BASIS OF DESIGN NARRATIVE

These Outline Specifications reference the "SSFUSD District Standards Living Doc 2025_0501 DRAFT" – Updated 8/3/26 and "10.21.24_DRAFT_SSFUSD_High School Educational Specifications" (referenced as 'Standards' or 'District Standards' or "Education Specification" in this document), as received from the District for reference. All conditions in these Standards are not fully covered by these Outline Specifications, but where applicable, product basis of design and criteria references are made here to establish the base requirements for the project. Per District Request, the "Basis of Design CSI Sample" template was utilized, modified with the criteria, and will be referenced within this document as the "Basis of Design" or "B.O.D."

BUILDING STRUCTURES

- Buildings S1, S2, and N1 Foundations
  - The foundation is reinforced concrete footings 1'-6" – 2'-0" below grade for a primarily wood superstructure with some steel framing as required
  - See "B.O.D. – Section A"

- Buildings S1, S2, and N1 Superstructure
  - The building structures are single-story, primarily wood frame structure with PSL or GLB (both to be estimated) roof girders supporting a wood joist and plywood deck with steel columns, as required
  - Building S2 - See Option B on the structural drawings for an alternate structural system
  - Steel columns as noted on structural drawings
  - Mechanical equipment coupled with other electrical, data, and utility routing among will be roof mounted and concealed by raised parapets
  - See "B.O.D. – Section B10"

- Buildings N Modifications
  - Modifications to be isolated to nonstructural partition walls.
  - See architectural and structural drawings

BUILDING EXTERIOR CONSTRUCTION

- Exterior Walls Materials
  - Buildings S1, S2, and N1
    i. Description 3- Coat cement plaster exterior wall finish with trim components as shown on the exterior elevations.
       1. Building N1 West Elevation – Fiber cement board panel siding will be utilized where the new weight room building's exterior aligns over the existing Building N exterior due to constructability feasibility and proximity between the existing and proposed structure.
  - Buildings N Modifications
    i. See architectural drawings for infill conditions and match existing condtions
    ii. Alternate – Gym Restroom Modernization
       1. Description 3- Coat cement plaster exterior wall finish with trim components as shown on the exterior elevations over new WRB over new sheathing over existing studs with new thermal insulation and interior finishes
  - See "B.O.D. – Section B20"

- Exterior Windows
  - Punched Aluminum Framed Windows and Storefront Glazing system:
    i. See "B.O.D. - Aluminum-Framed Windows"

ii. See “B.O.D. - Aluminum Framed Storefront”
iii. See “B.O.D. – Flashing”
iv. See “B.O.D. – Sealants”
- Each classroom, dance studio, counseling space, and family resource center, and office adjacent to exterior wall assemblies will receive operable window inserts. Assume 20% of punched openings have operable window inserts. All windows on first floor will have opening limiters for security per District standard.

- External Doors
  - Entry Door Panels:
    i. See “B.O.D. - Fiberglass Reinforced Polyester Doors”
  - Overhead Coiling Doors:
    i. See “B.O.D. - Exterior Overhead Coiling Doors”
  - Doors serving unconditioned spaces:
    i. See “B.O.D. – Hollow Metal Doors”
  - Door Frames:
    i. See “B.O.D. - Aluminum-Framed Storefront”
    ii. See “B.O.D. – Hollow Metal Frames”
  - Door Hardware:
    i. See “B.O.D. – B2030 Door Hardware”
  - Alternate - Provide ADA compliant automatic door openers and high-low exterior and interior push pads at all doors requiring panic hardware at noted Exits.
  - Alternate -

- Roofing Type:
  - Buildings S1, S2, and N1:
    i. See “B.O.D. – Section B30”
    ii. See “B.O.D. – Thermal Insulation”
    iii. Description: To be provided on all low slope roof areas over proposed tapered rigid insulation, including at curbs under mechanical equipment or top of equipment pads.
  - Buildings N Reroofing:
    i. See “B.O.D. – Section B30”
    ii. Description: Base scope includes reroofing over existing tapered insultation with new gutter, flashing, and sealant
    iii. Alternate – Include new roof curbs at the low sloped roof with proposed new mechanical equipment. See mechanical drawings.

- Waterproofing / Drainage / Membrane:
  - See “B.O.D. – Storm Drainage Utilities”
  - See “B.O.D. – Vertical Waterproofing”
  - See “B.O.D. – Exterior Wall Framing – 1.c.”

<u>BUILDING INTERIOR CONSTRUCTION</u>

- Wall Framing:
  - See “B.O.D. – Partition Framing”
  - See “B.O.D. – Acoustic Insulation”

<u>INTERIOR FINISHES</u>

- Entry Mat Systems at Exterior Doors
  - Exterior doors are to receive an entry mat system for a minimum of 4’ deep at the interior side of the door per plan.
  - Width of entryway system is to be 5’ wide at single doors and 6’ wide at double doors.
  - Resilient transition strip is to be used at the perimeter of entry mat to adjacent finishes.

- See "B.O.D. – Entrance Floor Mats"

- Classrooms Finishes
  - Floors
    i. See "B.O.D. – Polished Concrete Floors"
    ii. For Construction Technology Classroom use "Sealed Concrete Floors"
      1. See "B.O.D. – Concrete Floor Sealer"
  - Base
    i. See "B.O.D. – Resilient Flooring – 2."
  - Walls are painted gypsum wall board, with in-wall backing for mounting of classroom teaching wall components, white boards, instructional equipment, and shelving. 30% of drywall surfaces to include 1" acoustical panels.
    i. See "B.O.D. – Gypsum-Wallboard"
    ii. See "B.O.D. – Painting"
    iii. See "B.O.D. – Fabric-Wrapped Sound Absorbing Wall Panels (Tackable)"
    iv. See "B.O.D. – Visual Display Surfaces"
    v. See "B.O.D. – Instructional Equipment"
  - Ceiling is to be a suspended acoustical tile system.
    i. See "B.O.D. – Acoustical Panel Ceiling – 1. & 3."
    ii. All exposed mechanical systems to be painted.
  - Window Shades: Provide manual control shades at exterior windows.
    i. See "B.O.D. – Manual Roll-Down Shades"

- Dance Studio and Weight Room Finishes
  - Floors
    i. See "B.O.D. – Specialty Flooring"
    ii. See "B.O.D. – Resilient Flooring – 1."
  - Base
    i. See "B.O.D. – Resilient Flooring – 2."
  - Walls are painted gypsum wall board, with in-wall backing for mounting of classroom teaching wall components, white boards, instructional equipment, and shelving. 30% of drywall surfaces to include 1" acoustical panels. 30% to floor to wall mirror
    i. See "B.O.D. – Gypsum-Wallboard"
    ii. See "B.O.D. – Painting"
    iii. See "B.O.D. – Wall Mounted Full Length Mirrors"
    iv. See "B.O.D. – Fabric-Wrapped Sound Absorbing Wall Panels (Tackable)"
    v. See "B.O.D. – Visual Display Surfaces"
    vi. See "B.O.D. – Instructional Equipment"
  - Ceiling is to be a suspended acoustical tile system.
    i. See "B.O.D. – Acoustical Panel Ceiling – 1. & 3."
    ii. All exposed mechanical systems to be painted.
  - Window Shades: Provide manual control shades at exterior windows.
    i. See "B.O.D. – Manual Roll-Down Shades"

- Construction Technology Lab Finishes
  - Floors
    i. See "B.O.D. – Concrete Floor Sealer"
  - Base
    i. See "B.O.D. – Resilient Flooring – 2."
  - Walls are al plywood paneling, with in-wall backing for mounting of classroom teaching wall components, white boards, instructional equipment, PPE wire storage, extension ladder training platforms, and shelving. 30% of surface to include acoustical wood panels.
    i. See "B.O.D. – Plywood Paneling"
    ii. See "B.O.D. – Acoustical Wood Panel"
    iii. See "B.O.D. – Metal Storage Shelving"

- Ceiling open to structure above
    i. All exposed mechanical systems to be painted.
- Window Shades: Provide manual control shades at exterior windows.
    i. See "B.O.D. – Manual Roll-Down Shades"

- Community Liason & Counseling Finishes
    - See architectural drawings
    - Floors
        i. See "B.O.D. – Resilient Flooring – 1."
    - Base
        i. See "B.O.D. – Resilient Flooring – 2."
    - Walls are painted gypsum wall board, with in-wall backing for mounting of electronic screens and white marker board at the counseling conference and small meeting room. Provide in-wall backing and shelving within clothing and food storage at the community liasson office. 30% of drywall surfaces within the Small Group Room to include 1" acoustical panels.
        i. See "B.O.D. – Gypsum-Wallboard"
        ii. See "B.O.D. – Painting"
        iii. See "B.O.D. – Fabric-Wrapped Sound Absorbing Wall Panels (Tackable)"
        iv. See "B.O.D. – Visual Display Surfaces"
        v. See "B.O.D. – Instructional Equipment"
        vi. See "B.O.D. – Metal Storage Shelving"
    - Ceiling is to be a suspended acoustical tile system.
        i. See "B.O.D. – Acoustical Panel Ceiling – 1. & 3."
        ii. All exposed mechanical systems to be painted.
    - Window Shades: Provide manual control shades at exterior windows.
        i. See "B.O.D. – Manual Roll-Down Shades"

- Multi-User Restroom Finishes at Building S2 (Students)
    - Floors
        i. See "B.O.D. – C3020 – Ceramic Tile"
    - Base
        i. See "B.O.D. – C3010 – Ceramic Tile"
    - Walls are to be finished per District Standard. Back required for toilet accessories and toilet compartments.
        i. See "B.O.D. – C3010 – Ceramic Tile" -
        ii. See "B.O.D. – Gypsum-Wallboard"
        iii. See "B.O.D. – Painting"
        iv. See "B.O.D. – Toilet Compartments"
        v. See "B.O.D. – Toilet Room Accessories"
    - Ceiling
        i. See "B.O.D. – Suspended Gypsum Board Ceiling"
        ii. All exposed mechanical systems to be painted.

- Restroom Finishes at Building N
    - Floors
        i. See "B.O.D. – Sealed Concrete"
    - Base
        i. See "B.O.D. – C3010 – Ceramic Tile"
    - Walls are to be finished per District Standard. Back required for toilet accessories and toilet compartments.
        i. See "B.O.D. – C3010 – Ceramic Tile" -
        ii. See "B.O.D. – Gypsum-Wallboard"
        iii. See "B.O.D. – Painting"
        iv. See "B.O.D. – Toilet Compartments"
        v. See "B.O.D. – Toilet Room Accessories"

  - Ceiling
    i. See “B.O.D. – Suspended Gypsum Board Ceiling”
    ii. All exposed mechanical systems to be painted.

- Single-User Restroom Finishes (Staff)
  - Floors
    i. See “B.O.D. – Resinous Flooring”
  - Base
    i. See “B.O.D. – C3010 – Ceramic Tile”
  - Walls are to be finished per District Standard. Back required for toilet accessories and toilet compartments.
    i. See “B.O.D. – C3010 – Ceramic Tile”
    ii. See “B.O.D. – Gypsum-Wallboard”
    iii. See “B.O.D. – Painting”
    iv. See “B.O.D. – Toilet Room Accessories”
  - Ceiling
    i. See “B.O.D. – Suspended Gypsum Board Ceiling”
    ii. All exposed mechanical systems to be painted.

- Locker Rooms, Coaches Offices, and Dressing Room Finishes
  - Floors
    i. See “B.O.D. – Sealed Concrete”
    ii. Provide accessible and standard benches as indicated and required
      1. See architectural drawings
      2. See “B.O.D. – Locker Room Benches”
  - Base
    i. See “B.O.D. – Resilient Flooring – 2.”
  - Walls are to be provided with backing where wall-mounted lockers and attachments require
    i. See “B.O.D. – Gypsum-Wallboard”
    ii. See “B.O.D. – Painting”
    iii. See “B.O.D. – Metal Lockers”
    iv. See “B.O.D. – Toilet Compartments”
    v. See “B.O.D. – Toilet Room Accessories”
  - Ceiling
    i. See “B.O.D. – Suspended Gypsum Board Ceiling”
    ii. All exposed mechanical systems to be painted.

- Laundry
  - Floors
    i. See “B.O.D. – Polished Concrete Floors” – Building S1
    ii. See “B.O.D. – Concrete Sealant” – Building N
  - Base
    i. See “B.O.D. – Resilient Flooring – 2.”
  - Walls
    i. See “B.O.D. – Plastic Paneling (FRP)” (To T.O. Door Frame)
    ii. See “B.O.D. – Gypsum-Wallboard” (above FRP)
  - Ceiling
    i. See “B.O.D. – Suspended Gypsum Board Ceiling”
    ii. All exposed mechanical systems to be painted.

- Storage
  - Floors
    i. See “B.O.D. – Concrete Sealant”
  - Base
    i. See “B.O.D. – Resilient Flooring – 2.”
  - Walls

i. See "B.O.D. – Plywood Paneling" (Construction Technology)
ii. See "B.O.D. – Gypsum-Wallboard" (Building N, Dance Storage S1-10, and Building S2)

- Ceiling
  i. Open to Structure Above

- Janitor & Fire Riser
  - Floors
    i. See "B.O.D. – Sealed Concrete"
  - Base
    i. See "B.O.D. – Resilient Flooring – 2."
  - Walls
    i. See "B.O.D. – Plastic Paneling (FRP)" (8'-0" above finish floor)
    ii. See "B.O.D. – Gypsum-Wallboard"(above FRP)
  - Ceiling
    i. Open to structure above

- Service Spaces (Mechanical, Electrical, and Data)
  - Floors
    i. See "B.O.D. – Sealed Concrete"
  - Base
    i. None
  - Walls
    i. See "Plywood Backing"
  - Ceiling
    i. Open to structure above

UTILITIES

- Site Routing of Utilities:
  - Utilities are designed to be routed below grade.
- Mechanical, Plumbing and Fire Protection:
  - Piping pathways are to be coordinated above the suspended acoustical ceiling systems or gypsum ceilings where they occur.
  - Any exposed routing of utilities pathways must be coordinated with Architect prior to any approval of this condition.
  - Automatic sprinkler system complete with fire alarm system is to be provided where required by code. See general sheets.
- Electrical and Lighting Systems:
  - Routing of these systems must also be fully concealed above ceiling or soffits shown on the reflected ceiling plans and must be coordinated with Architect prior to approval of any exposed pathways being deemed acceptable.
  - All conduit runs to be embedded in concrete slabs are to be coordinated with Architect and design team.
  - No exposed conduits will be acceptable unless approved prior to installation.
  - Lay-in 2'x2' light fixtures are to be provided at suspended acoustical ceiling tile locations.
  - Lighting at all outdoor locations must be vandal resistant.
  - Provide minimal outdoor egress lighting at perimeter of building.
- Telephone / Data / Audio Visual:
  - Provide for wireless hubs within building and exterior coverage for both building outdoor spaces and outdoor courtyard at ground level.
  - See District Standards and Education Specification for required data drops in each classroom, office and miscellaneous spaces.
- Security
  - District Standard to be provided.

EQUIPMENT AND FURNISHINGS

- Project is responsible for providing in-wall backing, power, and data as instructed by the District for noted owner furnished equipment.
- Project is to provide:
  - See “B.O.D. – Manual Roll-Down Shades”
  - See “B.O.D. – Institutional Equipment”
  - See “B.O.D. – Commercial Laundry and Dry Cleaning”
  - See “B.O.D. – Metal Lockers”
  - See “B.O.D. – Interior Architectural Woodwork”
  - See “B.O.D. – Metal Storage Shelving”

EXTERIOR IMPROVEMENTS

- For scope of work for exterior improvements, see landscape and civil drawings and specifications.
  - See “B.O.D. – Section G – Sitework”
  - See civil and landscape drawings
  - See associated outline specifications

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District to provide Division 01.

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OUTLINE SPECIFICATIONS

DIVISION 21 – FIRE SUPPRESSION

21 00 00 FIRE SUPPRESSION SYSTEM DESIGN BUILD

Install fire sprinkler system for protection of all required areas of the entire building including void spaces unless specific exceptions of NFPA 13 are met. Items required for this work include but are not limited to:

1. Automatic wet pipe fire sprinkler system.
2. Preparation of complete shop installation drawings for the fire sprinkler systems and approvals.
3. Required permits, licenses and inspections.
4. Cleaning, testing and adjusting.
5. Project record documents of work as installed.

Piping and equipment shall be identified per NFPA 13. This includes, but is not limited to, risers, valves (control, drain, test connection),
piping, and fire department connections.

DIVISION 22 - PLUMBING

22 05 00 COMMON WORK RESULTS FOR PLUMBING

The work of this Section includes submittal protocol, quality assurance, delivery/storage/handling, sequencing and scheduling for the plumbing discipline. Also included is piping materials and fittings, joining materials, dielectric fittings, mechanical sleeve seals, piping specialties, grouting, piping insulation, as well as cutting and patching.

22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

The work of this Section includes Hangers and Supports for plumbing system piping and equipment.

22 05 48 VIBRATION AND SEISMIC CONTROL FOR PLUMBING PIPING

The work of this Section includes vibration isolators and seismic controls for plumbing piping.

22 05 23 GENERAL DUTY VALVES FOR PLUMBING PIPING

The work of this Section includes ball and gate valves, balancing valves, and check valves required for plumbing piping.

Manufacturers:
Ball Valves:
1. Conbraco Industries
2. Nibco, Inc.
3. Milwaukee Valve Company
4. Or Equal

Butterfly Valves:
1. Hammond Valve
2. Crane Co.
3. Milwaukee Valve Company
4. Or Equal

Flow Controls:

1. ITT Bell & Gossett
2. Griswold Controls
3. Taco, Inc.
4. Or Equal

Swing Check and Spring Loaded Check Valves:
1. Hammond Valve
2. Nibco, Inc.
3. Milwaukee Valve Company
4. Or Equal

Temperature and/or Pressure Relief:
1. Cla-Val Co.
2. Henry Technologies
3. Watts Regulator Company
4. Or Equal

Strainers:
1. Armstrong International, Inc.
2. Green Country Filter Manufacturing
3. WEAMCO

22 07 00 PLUMBING INSULATION

The work of this Section includes pipe insulation materials, jackets, vapor retardents, and accessories and attachments for plumbing piping insulation. The section also includes a schedule of requirements for piping insulation.

22 11 16 DOMESTIC WATER PIPING

The work of this Section includes pipe material, pipe fittings and joining materials for the domestic water piping system. The section also includes execution for installation, testing, cleaning, and commissioning of the domestic water piping system.

22 13 16 SANITARY WASTE AND VENT PIPING

The work of this Section includes pipe material, pipe fittings and joining materials for the sanitary waste and vent piping system. The section also includes execution for installation of the san waste and vent piping system.
Manufacturers:
Cast Iron Soil Pipe:
1. AB&I Foundry
2. Charlotte Pipe
3. Tyler Pipe
4. Or Equal

22 33 00 ELECTRIC, DOMESTIC-WATER HEATERS

Point of use electric water heaters below lav’s. Eemax or equivliant.

22 40 00 PLUMBING FIXTURES

Manufacturers:

Drinking Fountain:
1. Haws
2. Elkay Manufacturing Company or Equal

Water Closets:
1. Zurn Industries

2. American Standards, Inc. or Equal

Faucet:
1. Chicago Faucets
2. T&S Brass or equal

Flush Valves:
1. Sloan Valve Company or equal

Lab Turret:
1. Chicago Faucets or equal

Seats:
1. Bemis Manufacturing
2. Zurn Industries or equal

Water Closet Carriers:
1. JOSAM Company
2. ZURN Industries or equal

Flush Valve Water Closet ADA:
1. American Standards, Inc.
2. Zurn Industries

Urinals:
1. Acorn Engineering Co.
2. American Standard Companies, Inc.
3. Briggs Plumbing Products, Inc.
4. Capizzi
5. Crane Plumbing, LLC
6. Duravit USA, Inc.
7. Eljer

Lavatory Faucet:
1. Chicago Faucets – 857-E2805-665PSHAB
2. Chicago Facuets – 3600-E2805AB for Dual Supply.

Lavatory:
1. American Standard Inc – Lucerne 0356.421 (1 hole)
2. Kohler Company – K-12643 (1 hole)
3. American Standard – Lucerne 0355.034

Mop Sinks
1. Acorn
2. Florestone or Equal

DIVISION 23 – HEATING, VENTILATING, & AIR CONDITIONING

23 05 00	COMMON WORK RESULTS FOR HVAC The work of this Section includes submittal protocol, quality assurance, delivery/storage/handling, sequencing and scheduling for the mechanical discipline. Also included is piping materials and fittings, joining materials, dielectric fittings, mechanical sleeve seals, piping specialties, grouting, piping insulation, as well as cutting and patching.
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

The work of this Section includes Hangers and Supports for mechanical system piping and equipment.

23 05 48 VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

The work of this Section includes vibration isolators and seismic controls for plumbing piping.

23 05 93 TESTING ADJUSTING AND BALANCING FOR HVAC

The work of this Section includes:

1. Balancing airflow within distribution systems, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC and plumbing equipment.
4. Setting quantitative performance of HVAC and plumbing equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this Section.
7. Adjustment of recirculating domestic hot water return system.

23 07 00 HVAC INSULATION

The work of this Section includes pipe insulation materials, jackets, vapor retardents, and accessories and attachments for HVAC piping and equipment insulation. The section also includes a schedule of requirements for piping insulation.\

Manufacturer:
1. Knauf Insulation
2. Johns Manville Corporation
3. Owens Corning Corp

23 21 13 HYDRONIC PIPING

The work of this Section includes pipe fittings for heating water piping system, equipment drains and overflows, and equipment make-up water piping system. It also includes globe or angle, ball, butterfly, and check valves.

23 21 23 HVAC PUMPS

The work of this Section includes heating hot water pumps for the hydronic system.

23 21 33 HYDRONIC SPECIALTIES

The work of this Section includes expansion tanks, air separators, flow indicators, controls, meters, relief valves, and pump accessories.

23 31 13 METAL DUCTS

The work of this Section includes sheet metal materials, duct liner, sealant materials, hangers and supports, and duct fabrication.

23 33 00 AIR DUCT ACCESSORIES

The work of this Section includes manual-volume dampers, turning vanes, flexible connectors, flexible ducts, accessories.
Filter Manufacturers:
1. American Filtration, Inc.
2. AAF International/American Air Filter
3. Camfil Farr Company

23 34 23 HVAC POWER VENTILATORS

The work of this Section includes ceiling mounted and inline centrifugal fans, motors, factory finishes, and quality control of ventilators.
Manufacturers:

1. Greenheck
2. Panasonic
3. Broan
Or Equal

23 37 00 AIR OUTLETS AND INLETS

The work of this Section includes diffusers, registers, grilles, and louvers.

Manufacturers:
1. Carnes Company HVAC
2. Krueger
3. Titus
4. Ruskin
Or Equal

DIVISION 26 - ELECTRICAL

26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

The work of this Section includes supporting devices for electrical components, electricity-metering components, concrete equipment bases, electrical demolition, cutting and patching for electrical construction, and touchup painting.

26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

The work of this Section includes building wires and cables and associated connectors, splices, and terminations for wiring.

26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

The work of this Section includes grounding of electrical systems and equipment.

26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

The work of this Section includes raceways, boxes, enclosures and cabinets for the electrical systems.

26 05 48 VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS

Electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

26 24 00 SWITCHBOARDS AND PANELBOARDS

This Section includes service and distribution switchboards, load centers and panelboards, overcurrent protection devices, and associated auxiliary equipment.

Power Panel Boards:
1. Eaton
2. General Electric Company
3. Siemens Energy
4. Square D
5. Or Equal

26 27 26 WIRING DEVICES

This Section includes:
1. Receptacles, receptacles with integral GFCI and associated device plates
2. Wall-box motion sensors
3. Isolated ground receptacles
4. Snap switches and wall box dimmers

5. Solid state fan speed controls

26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

This Section includes individually mounted switches and circuit breakers for the following:

1. Service Disconnect Switches.
2. Feeder And Equipment Disconnect Switches.
3. Feeder Branch-Circuit Protection.
4. Motor Disconnect Switches.

Manufacturers:

Nonfusible Switches / Molded-Case Circuit Breakers

1. Eaton Corporation
2. General Electric Company
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric
5. Or Equal

Shunt Trip Switches:

1. Cooper Busmann
2. Littlefuse, Inc.
3. Or Equal

26 51 00 INTERIOR LIGHTING

This section includes:

1. Interior Lighting Fixtures
2. Lamps
3. Ballasts
4. Exit Signs
5. Emergency Lighting Units
6. Accessories

Manufacturers:

1. Lithonia Lighting
2. Finelite

26 60 00 LIGHTING ACCESSORIES

This section includes:

1. Time Switches
2. Photoelectric Relays
3. Occupancy Sensors
4. Multi-pole Lighting Relays and Contactors.

Manufacturers:

Lighting Controls:

1. Wattstopper
2. Cooper Industries, Inc.
3. Lithonia Lighting
4. Acuity Brands Lighting, Inc.
5. Creston, Inc.
6. Lutron

DIVISION 28 – FIRE ALARM

28 313 11 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

Basis of Design:

1. FACP: Siemens XLS, CSFM 7165-0067:0222 (No Substitution)
2. Smoke Detector: Siemens FP-11, CSFM 7272-0067:0203
3. Heat Detector: Siemens FPT-11, CSFM 7270-0067:0202
4. Speaker/Strobe: Siemens SEFH-HMC-R, CSFM 7125-0067:0272

5. Speaker: Siemens SEFH-R, CSFM 7320-0067:0273
6. Fire Alarm Enclosures: Siemens Fire Finder XLS CAB
7. Person Machine Interface 3: Siemens PMI-3 for FireFinder XLS
8. Card Cage Slots: Siemens CC-2, CC-5
9. Switch-Control Module: Siemens SCM-8
10. Live Voice Module: Siemens LVM
11. Digital Audio Card and Local Page Board: Siemens DAC-NET and LPB
12. Network Interface Card: Siemens NIC-C

END OF OUTLINE SPECIFICATIONS

SECTION 02 41 05 - TREE PROTECTION

PART 1- GENERAL

1.1 DEFINITIONS

A. Tree Protection Zone (TPZ): Area surrounding individual trees or groups of trees to remain during construction, and defined by the root zone of individual trees or groups of trees, unless otherwise indicated.

B. Tree Protection Zone to be designated by the owner's qualified arborist and based upon a radial distance from the base of the tree equal to one-foot radial distance for every one-inch in tree diameter measured at 4 ½ feet above soil grade (Diameter at Breast Height). The zone can be altered based upon tree species, soil texture and the actual presence of roots determined through soil investigation. Working inside of the designated tree protection area requires special rules, procedures and supervision.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For tree service firm and arborist.

C. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

D. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

1.3 QUALITY ASSURANCE

A. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed tree protection and trimming work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of tree protection and trimming.

B. All tree work, removal, pruning, planting, shall be performed using industry standards as established by the International Society of Arboriculture. Contractor must have a State of California Contractors License for Tree Service (C61-D49) or Landscaping (C-27) with general liability, worker's compensation, and commercial auto/equipment insurance.

C. Contractor standards of workmanship shall adhere to current Best Management Practices of the International Society of Arboriculture (ISA) and the American National Standards Institute (ANSI) for tree pruning, fertilization and safety (ANSI A300 and Z133.1).

D. Arborist Qualifications: An arborist certified by ISA or licensed in the jurisdiction where Project is located.

E. Arborist Supervision: Activities occurring inside of the designated TPZ must be approved and an arborist must be present to supervise tree protection and root pruning activities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: See Planting Section 32 29 00.

B. Chain-Link Fence: Metallic-coated steel chain-link fence fabric of 0.120-inch- diameter wire; a minimum of 72 inches high; with 1.9-inch- diameter line posts; 2-3/8-inch- diameter terminal and corner posts; 1-5/8-inch-diameter top rail; and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.

C. Mulch: Material is wood chips generated from tree trimming. Fresh redwood, incense cedar and walnut chips are not acceptable, nor is palm generated mulch or use mulch specified in Section 32 29 00.

PART 3 - EXECUTION

3.1 PROTECTION

A. Pre-Construction Meeting: It is important that construction crew understands the tree protection requirements. Personnel working on site should be provided an orientation to tree preservation measures and rules by the arborist assigned to monitor tree preservation.

B. Install a temporary 6-foot high metal chain link fence at the "tree protection zone" of the tree(s). Install chain-link fence as specified and shown on drawings as directed by the Arborist or Landscape Architect. Maintain temporary fence and remove when construction is complete.

C. Protect trees against cutting, breaking, skinning and bruising of bark; permit no traffic or stockpiling within tree root protection zone.

D. Do not change earth surface within tree protection zone of trees.

E. Do not park vehicles or store materials, supplies, excavated material or construction equipment within root protection zone of trees. Do not permit vehicles or foot traffic within tree root protection zones; prevent soil compaction over root systems.

F. Obtain specific instruction from Arborist or Landscape Architect for pruning of trees, or disturbance of soil within spread of tree branches and for removal of roots.

G. Any trenching required within the root zone shall be done by hand and as directed by the Arborist or Landscape Architect.

H. Provide supplemental irrigation as designated by the Arborist based on the level of root loss, soil conditions, tree health and time of year.

I. Provide watering for existing within Contract limit and any adjacent areas affected by the work.

J. Protect tree systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

K. Maintain tree protection zones free of weeds and trash.

L. Do not allow fires within tree protection zones.

3.2 INSPECTION SCHEDULE

A. For optimal tree protection, the following inspection schedule is recommended:

1. Inspection of site: Prior to Equipment and Materials Move In, Site Work, Demolition and Tree Removal: The Project Arborist will meet with the General Contractor, Architect / Engineer, and Owner or their representative to review tree preservation measures, designate tree removals, delineate the location of tree protection / nonintrusion zone (NIZ) fencing, specify equipment access routes and materials storage areas, review the existing condition of trees and provide any necessary recommendations.

2. Inspection of site: After installation of NIZ fencing: Inspect site for the adequate installation of tree preservation measures. Review any requests by contractor for access, soil disturbance or excavation areas within root zones of protected trees. Assess any changes in the health of trees since last inspection.

3. Inspection of site: During excavation or any activities that could affect trees: Inspect site during any activity within the Non-Intrusion Zones of preserved trees and any recommendations implemented. Assess any changes in the health of trees since last inspection.

4. Final Inspection of Site: Inspection of site following completion of construction: Inspect for tree health and make any necessary recommendations

3.2 ARBORIST'S CHECKLIST

A. An urban forester, certified or consulting arborist shall establish the Tree Protection Zone (TPZ) prior to starting the demolition work. Four-foot-high metal wire deer fencing will be erected by the contractor and inspected by the arborist to limit access to the TPZ. This will protect the trunk and root zone throughout construction.

B. The Arborist shall have a pre-demolition meeting with contractor or responsible party and all other foremen or crew managers on site prior to any work to review all work procedures, access and haul routes, and tree protection. The contractor must notify the Arborist if roots are exposed or if trunk or branches are wounded.

C. Any trunk and root crown that is not protected by a TPZ where heavy equipment operation is likely to wound the trunk, install a barrel stave-like trunk wrap out of 2 X 4 studs connected together with metal straps, attached to the 2 X 4's with driver screws or 1" nails.

D. Storage of equipment shall be as far away from protected trees as possible and optimally on asphalt or ground protected by mulch / plywood.

E. Heavy equipment use should be limited around trees and the roots. No equipment may be transported or used on bare ground within the root zone. A 6" layer of mulch and plywood must be placed under the path for access and egress. The protective "bridge' shall be maintained by the contractor and inspected by the arborist when on site.

F. Any damage to trees due to demolition or construction activities shall be reported to the arborist within 6 hours, so that remedial action can be taken. Any damage done to the trees in violation of the contract agreement shall be appraised as a casualty loss by the arborist and provided to the tree owner.

G. All trenching within the NIZ shall be done pneumatically or by hand, being careful not to damage any of the bark of any root encountered.

H. An arborist shall inspect all grading, trenching, tunneling or other excavation within the root zones of trees prior to backfill.

I. No chemicals or other waste materials shall be dumped within 20’ of the base of any tree. There shall be no material storage in the NIZ.

J. Pier and at-grade beam foundation construction should be used around the tree to avoid root damage.

K. The top 3’ of any pier located inside a NIZ shall be pneumatically excavated or hand dug then inspected by the arborist prior to drilling for piers to avoid major roots. Any minor roots (<3.5") encountered can be cut cleanly with a saw after excavation.

L. Chimneys and other heat vents shall be screened and terminated or provided a trimmed clearance at least 10 feet from branches and foliage (See local fire codes).

M. Any tree pruning will be done in accordance with ISA standards. All pruning will be inspected by the arborist.

N. The arborist must perform a final inspection to ensure that no unmitigated damage has occurred and to specify any pest, disease or other health care. The arborist shall specify and oversee any necessary restorative actions.

O. Any suspected omissions or conflict between various elements of the plan shall be brought to the attention of the arborist and resolved before proceeding with the work.

3.2 EXCAVATION

A. Install shoring or other protective support systems to minimize sloping or benching of excavations.

B. Do not excavate within tree root protection zones, unless otherwise indicated.

C. Where utility trenches are required within tree protection zones, tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.

D. Root Pruning:

1. Root Pruning: Root protection measures must be in place prior to the beginning of construction activities. Necessary root pruning is best accomplished prior to the beginning of construction activities when excavation equipment will be used. After being exposed by hand or air excavation, roots are pruned under arborist supervision. Construction activities are then free to occur outside of the root pruning boundary.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

A. Minor Fill: Where existing grade is 6 inches or less below elevation of finish grade, fill with sand. Place sand in a single uncompacted layer and hand grade to required finish elevations.

3.4 MULCHING

A. Mulching – During construction place and maintain four to six inches of organic mulch to reduce soil compaction and evaporative soil moisture loss with the Tree Protection Zone. Place mulch as shown on the Planting Plan.

3.5 PRUNING

A. Pruning: comply with ANSI A300 Pruning Standards. Pruning must be minimized, particularly when root loss occurs. Pruning prior to construction should include: Necessary clearance pruning, deadwood removal and safety pruning.

3.6 TREE REPAIR AND REPLACEMENT

A. Promptly repair trees damaged by construction operations within 24 hours. Treat damaged trunks, limbs, and roots according to arborist's written instructions.

B. Remove and replace trees indicated to remain that die or are damaged during construction operations that arborist determines are incapable of restoring to normal growth pattern.

1. Any protected trees that perish during construction or lost during the maintenance period, shall be replaced by contractor. Tree value shall be determined by school district using formula adopted by the "guide for plant appraisal", latest edition, international society of arboriculture. An International Society of Arboriculture or National Arborist's Association qualified tree surgeon may be retained by the school district to determine the condition of trees in question as to their ability to survive. Comply with recommendations to rehabilitate or to replace in accordance with paragraph above.

C. Aerate surface soil, compacted during construction, 10 feet beyond tree protection zone and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.7 DISPOSAL OF WASTE MATERIALS

A. Burning is not permitted.

B. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Inspector.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: All labor, materials and equipment and all operations required to complete all formwork as indicated on the drawings; to produce shapes and configurations as shown, as required; and as specified herein, including:

1. Forms, shores, bracing, removal and other operations as necessary for all cast-in-place concrete and masonry placed.
2. Setting and securing anchor bolts and other metal items embedded in concrete into formwork, using materials and layouts furnished and delivered to jobsite as specified under other sections.

B. Related Sections:

1. Pertinent Sections of Division 03 specifying concrete construction.
2. Pertinent Sections of other Divisions specifying work to be embedded in concrete or work penetrating concrete foundations and formwork.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 19A Concrete.

B. American Concrete Institute (ACI) PRC-347 "Guide to Formwork for Concrete".

C. American Plywood Association (APA) “Concrete Forming Guide”.

D. West Coast Lumberman Inspection Bureau (WCLIB) “Standard Grading Rules for West Coast Lumber”.

E. ACI MNL-66 “ACI Detailing Manual”.

F. ACI SPEC-301 “Specifications for Concrete Construction”.

G. Concrete Reinforcing Steel Institute (CRSI) “Manual of Standard Practice”.

1.3 DESIGN REQUIREMENTS

A. Design, engineer, and construct formwork, shoring and bracing to conform to design and code requirements, resist imposed loads; resultant concrete to conform to required shape, line and dimension.

1.4 SUBMITTALS

A. Limitation of review: Structural Engineer's review will be required only where specifically requested for general architectural applications and features only. Contractor is responsible for structural stability, load-resisting characteristics and sufficiency of form work design.

1.5 QUALITY ASSURANCE

A. General: All form materials shall be new at start of work. Produce high quality concrete construction. Minimize defects due to joints, deflection of forms, roughness of forms, nonconforming materials, concrete or workmanship.

B. Reuse of Forms: Plywood forms may be reused, if thoroughly cleaned of all dirt, mortar, and foreign materials, and undamaged at edges and contact face. Reuse shall be subject to permission from the Architect without exception, and issued in writing. Reuse of any panel which will produce a blemish on exposed concrete, will not be permitted.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Form Materials:

1. Non-Exposed Surface Formwork Facing: Forms for concrete which is not exposed to view, may be of plywood as specified for exposed surfaces, or square edge 1x nominal Douglas Fir, Construction Grade, S4S.
2. Exposed Surface Formwork Facing:
   a. Forms for all exterior and interior concrete flat surfaces unless otherwise specified as board formed shall be new Douglas Fir Plywood (APA) ply, 5/8-inch, B-B Plyform, Class 1, Exterior Type, oiled and edged and edge-sealed conforming to U.S. Product Standard PS 1 in large sheet sizes to achieve joint patterns shown.
   b. All exposed concrete edges shall be chamfered 3/4" minimum or as noted on the drawings.
3. Exposed Surface Formwork - Special Pattern Form Liner:
   a. Forms for all exterior and interior concrete flat surfaces indicated shall be as designated by Architect.

B. Earth Forms: Allowed, subject to soil standing in excavations without ravel or caving.

C. Form Release Agent: Spray-on compound, not affecting color, bond or subsequent treatment of concrete surfaces. Maximum VOC content shall comply with local requirements and California Green Building Code.

D. Accessories: Types recommended by manufacturers or referenced standards to suit conditions indicated;

1. Anchors, spacers, void in-fill materials: sized to resist imposed loads.
2. Form Ties: Prefabricated rod, flat band, or wire snap ties with 1" break-back or threaded internal disconnecting type with external holding devices of adequate bearing area. Ties shall permit tightening and spreading of forms and leave no metal closer than 1" to surface.

E. Corner Chamfers and Rustications: Filleted, wood strip or foam type; sizes and shapes as detailed, or 3/4 x 3/4 inch size minimum if not detailed; maximum possible lengths.

F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

G. Foam Block Formwork: For use only where specified on drawings to create void space under or within concrete. ASTM D6817.

Use Case	InsulFoam Geofoam (or equivalent)	Maximum Density (pcf)	Compressive Resistance at 1% Deformation (psi)	Compressive Resistance at 5% Deformation (psi)	Compressive Resistance at 10% Deformation (psi)
1) Void formwork	EPS-15	0.90	3.6	8.0	10.2
2) Planters	EPS-19	1.14	5.8	13.1	16.0
3) Pedestrian Loads (<=100psf)	EPS-22	1.35	7.3	16.7	19.6
4) Vehicular Loads and Sidewalks (<= 250psf)	EPS-39	2.40	15.0	35.0	40.0

PART 3 – EXECUTION

3.1 EXAMINATION

A. Inspect the substrate and the conditions under which concrete formwork is to be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work indicates acceptance of substrates and conditions.

B. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

A. If natural soil or compacted fill can be accurately cut and maintained, foundations and grade beams may be poured against earth without forming. Provide positive protection of trench top corners.

B. Maintain earth forms free of water and foreign materials.

3.3 ERECTION – FORMWORK

A. General: Construct formwork in accordance with calculations, and recommendations of ACI PRC-347. Construct forms to the sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in finished structure. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes.

1. Construct cambers specified in concrete members and slabs in the formwork.
2. Schedule the work and notify other trades in ample time so that provisions for their work in the formwork can be made without delaying progress of the project. Install all sleeves, pipes, etc. for building services systems, or other work. Secure information about and provide for all openings, offsets, recessed nailing blocks, channel chases, anchors, ties, inserts, etc. in the formwork before concrete placement.
3. Deflection: Formwork and concrete with excessive deflection after concrete placement will be rejected. Excessive deflection is that which will produce visible and noticeable waves in the finished concrete.

4. Measure formwork for elevated structural slabs, columns, wall elevations points of maximum camber and submit in writing to the Architect/Engineer prior to placing concrete.

B. Formwork Construction: Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301. Uniform, substantial and sufficiently tight to prevent leakage of concrete paste, readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials. Tie, brace, shore, and support to insure stability against pressures from any source, without failure of any component part and without excessive deflection. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

C. Provide all openings, offsets, inserts, anchorages, blocking, and other features of the work as shown or required. See INSERTS, EMBEDDED PARTS, AND OPENINGS for detailed requirements.

D. Warped, checked, or scuffed forms will be rejected.

E. Maintain membranes, reinforcing and other work free of damage; protect with plywood runway boards or other positive, durable means.

F. Align joints and make watertight. Keep form joints to a minimum.

G. Provide fillet and chamfer strips on external corners of exposed locations and as indicated to form patterns in finished work. Extend patterns around corners and into alcoves, on backs of columns and similar locations not otherwise shown.

1. Produce beveled, smooth, solid, unbroken lines, except as otherwise indicated to conform to patterns.
2. Form corners and chamfers with 3/4 inch x 3/4 inch strips, unless otherwise indicated, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer at changes in direction.

H. Unexposed corners may be formed either square or chamfered.

I. Ties and Spreaders: Arrange in a pattern acceptable to the Architect when exposed. Snap-ties may be used except at joints between pours where threaded internal disconnecting type shall be used.

J. Coordinate this section with other sections of work that require attachment of components to formwork.

K. Reglets and Rebates: Accurately locate, size, and form all reglets and rebates required to receive work of other trades, including flashing, frames, and equipment.

3.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not allow excess form coating material to accumulate in the forms or to come into contact with reinforcement or surfaces which will be bonded to fresh concrete.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork will be rejected.

E. Leave no residue or stain on the face of the concrete, nor affect bonding of subsequent finishes or work specified in other sections.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

1. Provide openings in concrete formwork to accommodate work of other sections including those under separate contracts (if any). Size and location of openings, recesses and chases shall be in accordance with the section requiring such items. Accurately place and securely support items to be built into forms.

B. Construction Joints: Construct and locate generally as indicated on Drawings and only at locations approved by Structural Engineer, so as not to impair the strength of the structure. Form keys in all cold joints shown or required.

C. Locate and set in place items that will be cast directly into concrete.

D. Rough Hardware and Miscellaneous Metal: Set inserts, sleeves, bolts, anchors, angles, and other items to be embedded in concrete. Set embedded bolts and sleeves for equipment to template and approved shop drawings prepared by trades supplying equipment.

E. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

F. Wood Inserts and Nailers: Provide approved preservative-treated lumber. Set all required nailing blocks, grounds, and other inserts as required to produce results shown. Wood plugs shall not be used.

G. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

H. Piping: Do not embed piping in structural concrete unless locations specifically approved by Structural Engineer.

I. Conduit: Place conduit below slabs-on-grade and only as specifically detailed on structural drawings. Minimum clear distance between conduits shall be 3 diameters. Location shall be subject to Engineer's written approval and shall not impair the strength of the structure.

J. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

1. Provide openings for the introduction of vibrators at intervals necessary for proper placement.
2. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

K. Install Form Liner inserts in accordance with manufacturer's recommendations, to produce patterns and textures indicated.

L. Install waterstops in accordance with manufacturer's recommendations to provide continuous waterproof barrier.

3.6 FORM CLEANING

A. Clean forms as erection proceeds, remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

1. Remove all dirt, chips, sawdust, rubbish, water and foreign materials detrimental to concrete.
2. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.7 FOOTINGS

A. Verify elevations and provide final excavation required for footings prior to placing of concrete.

3.8 SUPPORT STAKES

A. Where required to support formwork, steel stakes located within the concrete placement area shall be sleeved with PVC pipe of as small of size practical to fit the stake. Sleeves shall be filled with grout after removal of stake. Such stakes shall be located no closer than 48 inches on center each way.

B. Wood stakes shall not be used within the area of concrete placement.

3.9 EQUIPMENT BASES

A. Form concrete bases for all mechanical and electrical equipment in accordance with approved shop details furnished by other sections.

B. Sizes and locations as indicated and as required to produce results shown.

C. Provide coved base for all equipment bases placed on concrete slabs.

3.10 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI SPEC-301.

3.11 FOAM BLOCK FORMWORK

A. Blocks shall be placed on prepared leveling course for level bearing. Place adjacent blocks in tight contact together. Where placed in multiple layers, orient long axis of upper layer at 90° to lower layer, and so forth for subsequent layers. Anchor blocks as required to prevent movement prior to and during concrete placement. Do not expose to hydrocarbons, solvents, or coal tar.

3.12 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

B. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

C. Clean and repair surfaces to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

D. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.

3.13 FORM REMOVAL

A. Do not loosen or remove forms before minimum curing period has elapsed without employment of appropriate alternate curing methods, approved by the Architect in writing.

B. Remove forms without damage to the concrete using means to ensure complete safety of the structure and without damage to exposed beams, columns, wall edges, chamfers and inserts. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Do not remove forms until the concrete has hardened sufficiently to permit safe removal and the concrete has attained sufficient strength to safely support imposed loads. The minimum elapsed time for removal of forms after concrete has been placed shall be as follows:

1. Columns and Walls: 7 days, provided members are not subjected to overhead loads.
2. Retaining Walls: 21 days minimum.
3. Footings: 7 days minimum. If backfilled immediately, side forms may be removed 24 hours after concrete is placed.
4. Beams, elevated slab, and similar overhead conditions: 28 days unless adequate shoring is provided.

D. Durations listed above are minimums and are subject to extension at the sole judgment of the Architect/Engineer.

E. Reshoring: Reshore members where and if required by Formwork Design Engineer.

F. Do not subject concrete to superimposed loads (structure or construction) until it has attained full specified design strength, nor for a period of at least 14 days after placing.

G. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

3.14 CLEANING

A. Remove excess material and debris associated with this work from the job site.

END OF SECTION 03 10 00

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reinforcing steel work for all concrete and masonry work as indicated on the drawings and specified herein.
2. Coordinate this work with other work affected by these operations, such as forms, electrical work, mechanical work, structural steel, masonry and concrete.

B. Related Sections:

1. Pertinent Sections of Division 01 specifying Quality Control and Testing Laboratory services.
2. Pertinent Sections of Divisions 03 specifying concrete construction.
3. Pertinent Sections of Divisions 04 specifying masonry construction.
4. Pertinent Sections of other Divisions specifying work to be embedded in concrete or work penetrating concrete work.

1.2 REFERENCE STANDARDS

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC) Chapter 19A Concrete.

B. American Concrete Institute (ACI) SPEC-301 “Specifications for Concrete Construction”.

C. ACI CODE-318 “Building Code Requirements for Structural Concrete and Commentary”.

D. ACI MNL-66 “ACI Detailing Manual”.

E. ASTM International (ASTM) A1064 “Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete”.

F. ASTM A615 “Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement”.

G. ASTM A706 “Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement”.

H. American Welding Society (AWS) D1.4 – “Structural Welding Code - Steel Reinforcing Bars”.

I. Concrete Reinforcing Steel Institute (CRSI) - “Manual of Standard Practice”.

J. CRSI - “Placing Reinforcing Bars”.

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. Submit for review prior to fabrication.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer.

C. Shop Drawings: Show complete fabrication and placing details of all reinforcing steel. Comply with requirements of ACI MNL-66. Include:

1. Bar sizes and schedules;
2. Shapes of bent bars, layout and spacing of bars, location of splices.
3. Stirrup spacing, arrangements and assemblies,
4. References to Contract Document detail numbers and designations.
5. Wall elevations corresponding to elevations shown in Contract Documents.

D. Product Data: Submit manufacturer's product data, specifications, location and installation instructions for proprietary materials and reinforcement accessories. Provide samples of these items upon request.

E. Certificates: Submit all certifications of physical and chemical properties of steel for each heat number as manufactured, including location of material in structure as specified below in Article titled QUALITY ASSURANCE. All materials supplied shall be tagged with heat numbers matching submitted Mill Test Report analyses.

F. Samples: Provide to the Owner's Testing laboratory as specified in Article SOURCE QUALITY CONTROL.

1.4 QUALITY ASSURANCE

A. Perform work of this Section in accordance with the CRSI “Manual of Standard Practice”, CRSI “Placing Reinforcing Bars”, ACI SPEC-301, and ACI CODE-318.

B. Requirements of Regulatory Agencies, refer to pertinent Sections of Division 01 and CBC.

C. Certification and Identification of Materials and Uses: Provide Owner's Testing Agency with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection and all material identification/test information listed below.

1. Provide manufacturer's Mill Test Reports for all materials. Include chemical and physical properties of the material for each heat number manufactured. Tag all fabricated materials with heat number.
2. Provide letter certifying all materials supplied are from heat numbers covered by supplied mill certificates. Include in letter the physical location of each grade of reinforcing and/or heat number in the project (i.e. foundations, walls, etc.).
3. Unidentified Material Tests: Where identification of materials by heat number to mill tests cannot be made, Owner's Testing Agency shall test unidentified materials as described below.

D. Testing and Inspection: Tests and Inspections required by Independent Testing Agency are specified below in Articles SOURCE QUALITY CONTROL and FIELD QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs and test reports in conformance with pertinent Sections of Division 01.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent requirements of Division 01.

B. Deliver reinforcement to project site in bundles marked with durable tags indicating heat number, mill, bar size and length, proposed location in the structure and other information corresponding with markings shown on placement diagrams.

C. Handle and store materials above ground to prevent damage, contamination or accumulation of dirt or rust.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Reinforcing Steel: Deformed billet steel bars, ASTM A706 Grade 60 or ASTM A615 Grade 60.

1. Welded reinforcement shall be ASTM A706, or A615 meeting carbon requirements of AWS D1.4. Welding shall conform with AWS D1.4.
2. All reinforcement to be unfinished.
3. ASTM A615 reinforcement at special structural concrete walls, concrete coupling beams, and special concrete moment frames shall have maximum yield stress of 78,000 psi and the tensile strength shall be greater than 125% of the actual yield strength. Test ASTM A615 reinforcement for conformance to these criteria prior to fabrication and/or installation.

B. Welded Wire Reinforcement: ASTM A1064.

C. Tie Wire: No. 16 AWG or heavier, black annealed.

D. Concrete Blocks: On-grade conditions only, as required to support reinforcing bars in position.

E. Reinforcing Supports: Plastic or galvanized steel chairs, bolsters, bar supports, or spacers sized and shaped for adequate support of reinforcement and construction loads imposed during concrete placement, meeting ACI and CRSI standards.

1. For use over formwork: Galvanized wire bar type supports complying with CRSI recommendations. Provide plastic tips where exposed to view or weather after removal of formwork. Do not use wood, brick, or other unacceptable materials.

F. Reinforcement Splice Couplers: For use only where specified on drawings. Submit other locations proposed for use to Engineer for review. "L-Series Bar Lock" Coupler Systems for Splicing Reinforcement Bars, UES ER-0319, by Dayton-Superior Corporation.

2.2 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4), unless specifically shown otherwise. Details not specifically shown or indicated shall conform to MNL-66 and specified codes and standards.

1. Accurately shop-fabricate to shapes, bends, sizes, gauges and lengths indicated or otherwise required.
2. Bend bars once only. Discard bars improperly bent due to fabricating or other errors and provide new material; do not re-bend or straighten unless specifically indicated. Rebending of reinforcement in the field is not allowed.

3. Do not bend reinforcement in a manner that will injure or weaken the material or the embedding concrete.
4. Do not heat reinforcement for bending. Heat-bent materials will be rejected.

B. Unacceptable materials: Reinforcement with any of the following defects will not be permitted in the work.

1. Bar lengths, depths and bends exceeding specified fabrication tolerances.
2. Bends or kinks not indicated on Drawings or final shop drawings.
3. Bars with reduced cross-section due to rusting or other cause.

C. Tag reinforcement with durable identification to facilitate sorting and placing.

D. Shop Fusion Welded Stirrup/Tie/Spiral Cages

1. Shop fusion welding of stirrup/tie/spiral cages is permitted to aid in fabrication and handling. The following requirements shall be met.
2. All reinforcing bars receiving weld shall be ASTM A706.
3. Longitudinal holding wires shall be ASTM A1064.
4. Shop welding shall be performed by machines under a continuous, controlled process.
5. Quality control tests shall be performed on shop-welded specimens and the test results shall be available, upon request, to the Architect/Engineer.
6. Tack welding of reinforcing steel is not permitted.
7. Welding of any type shall not occur at 90°, 135°, or 180° bends. Circular ties and spirals may be shop fusion welded outside of areas with 90°, 135°, or 180° hook bends.
8. Longitudinal bars shall not be welded to stirrups/ties/spirals.

2.3 SOURCE QUALITY CONTROL

A. The Testing Agency, as specified in the Article QUALITY ASSURANCE, will perform the following:

1. Sampling and Tests of Reinforcing Bars per CBC 1910A.2.
2. Material Testing:
   a. Identified Steel: When samples are taken from bundled steel identified by heat number, matched with accompanying mill analyses as delivered from the mill, supplemental testing of reinforcing steel is not required.
   b. Unidentified Steel: When identification of materials by heat number matched to accompanying mill analyses cannot be made, perform one tensile test and one bend test per each two and one-half tons or fraction thereof for each required size of reinforcing steel. Tests of unidentified steel shall be performed by the Owner's Testing Agency and costs for these tests shall be paid by the Contractor by deductive change order.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Inspect the conditions under which concrete reinforcement is to be placed. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Coordinate with work of other sections to avoid conflicts or interference. Bring conflicts between reinforcement and other elements to Architect's attention. Resolve conflicts before concrete is placed.

C. Notify Architect, Structural Engineer, and Authority Having Jurisdiction for review of steel placement not less than 48 hours before placing concrete.

3.2 PLACEMENT

A. General: Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean bars free of substances which are detrimental to bonding. Maintain reinforcement clean until embedded in concrete.

C. Place reinforcement to obtain the minimum coverages for concrete protection. Do not deviate from required position. Maintain required distance, spacing and clearance between bars, forms, and ground.

D. Location and Support: Provide metal chairs, runners, bolsters, spacers and hangers, as required.

E. Provide additional steel reinforcement as necessary or as directed, to act as spreaders or separators to maintain proper positioning.

F. Tying and Attachment: Securely tie at all intersections and supports with wire. Prevent dislocation or movement during placement of concrete. Direct twisted ends of wire ties away from exposed concrete surfaces.

G. Separate reinforcing from pipes or conduits with approved non-metallic separators. Do not use wood or steel form stakes or reinforcement used as stakes as support for reinforcement.

H. Accommodate placement of formed openings required by other sections.

I. Obstructions:

1. Where obstructions, block-outs, or penetrations (conduits, raceways, ductwork) prevent continuous placement of reinforcement as indicated, provide additional reinforcing as detailed and as directed by the Structural Engineer to supplement the indicated reinforcement around the obstruction.
2. Place additional trim bars, ties, stirrups, or other elements as detailed and as directed at all opening, sleeves, pipes or other penetrations through structural elements.

J. Welded Wire Reinforcement: Reinforce slabs with 6"x 6"-W1.4 x W1.4 welded wire reinforcement reinforcing, unless otherwise noted on drawings.

1. Provide flat sheets only, no rolls. Straighten, cut to required size, and lay out flat in place.
2. Securely wire-tie reinforcement to other reinforcement at frequent intervals.
3. Extend reinforcement over supporting beams and walls, and to within 1 inch of edge of slabs, construction joints, and expansion joints.
4. Support reinforcement in mid-depth of slab.
5. Lift reinforcement at intervals as slab concrete is placed, ensure proper embedment.

3.3 REINFORCING SPACING AND COVERAGE

A. Spacing: Do not space bars closer than four (4) diameters of the largest of two adjacent bars, except at bar laps, which shall be placed such that a minimum of 2 bar diameters is clear between bars.

B. Where reinforcing in members is placed in two layers, the distance between layers shall not be less than four bar diameters of the largest bar and the bars in the upper layers shall be placed directly above those in the bottom layer, unless otherwise detailed or dimensioned.

C. Coverage of bars (including stirrups and columns ties) shall be as follows, unless otherwise shown:

1. Concrete cast against earth or grade: 3 inches.
2. Concrete exposed to weather or formed and exposed to earth:
   a. #5 & smaller: 1-1/2 inches.
   b. #6 & larger: 2 inches.
3. Concrete not exposed to earth or weather:
   a. #5 & smaller: 1 inch.
   b. #6 & larger: 1-1/2 inches.

3.4 DOWELS, SPLICES, OFFSETS AND BENDS

A. Provide standard reinforcement splices at splices, corners, and intersections by lapping ends, placing bars in contact, and tightly tying with wire at each end. Comply with details shown on structural drawings and requirements of ACI CODE-318.

B. Provide minimum 1-1/2 inch clearance between sets of splices. Stagger splices in horizontal bars so that adjacent splices will be 4 feet apart.

C. Laps of welded wire reinforcement shall be at least two times the spacing of the members in the direction lapped but not less than twelve inches.

D. Splices of reinforcement shall not be made at points of maximum stress. Provide splice lengths as noted on the structural drawings, with sufficient lap to transfer the stress between bars by bond and shear.

E. Spacing:

1. Space bars minimum distance specified and all lapped bars 2 bar diameters (minimum) clear of the next bar.
2. Stagger splices of adjacent bars where possible and where required to maintain bar clearance.
3. Beam or slab top bars shall be spliced mid-span of column support and bottom bars spliced at column supports.
4. Request Architect/Engineer review prior to placement for all splices not shown on the drawings.

F. Reinforcement Couplers: Install at all locations indicated. Install couplers in accordance with manufacturer’s recommendations.

3.5 WELDING

A. No reinforcing shall be welded unless specifically indicated. No reinforcing shall be welded without prior approval of the Structural Engineer and the Authority Having Jurisdiction.

B. Only when so approved for use as noted above, all welding shall conform to AWS D1.4, ACI CODE-318, and the following;

1. All welding performed by certified welders.
2. All reinforcement requires preheat prior to welding. All preheat and welding shall be continuously inspected by the Testing Agency.

3.6 MISPLACED REINFORCEMENT

A. Notify Architect/Engineer immediately if reinforcing bars are known to be misplaced after concrete has been placed.

B. Perform no correction or cutting without specific direction. Do not bend or kink misplaced bars.

C. Correct misplaced reinforcing only as directed in writing by the Architect/Engineer. Bear all costs of redesign, new, or additional reinforcing required because of misplaced bars at Contractor's expense.

3.7 FIELD QUALITY CONTROL

A. The Testing Agency as specified in the Article QUALITY ASSURANCE, will inspect the work for conformance to contract documents before concrete placement.

1. Inspection: Provide inspection and verification of installed reinforcement. Confirm that the surface of the rebar is free of form release oil or other coatings.
2. Inspect all preheat and welding activities for steel reinforcement, when these occur.
3. Exception: Non-structural patios, driveways, and sidewalks do not require special inspection.

3.8 CLEANING

A. Remove excess material and debris associated with this work from the job site.

END OF SECTION 03 20 00

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Provide all labor, materials, equipment and services to complete all concrete work required, including, but not limited to, the following:

1. Foundations, beams, columns, elevated slabs, slabs-on-ground, walls, and retaining walls.
2. Installation of all bolts, inserts, sleeves, connections, etc. in the concrete.
3. Joint devices associated with concrete work.
4. Miscellaneous concrete elements, including, but not limited to: equipment pads, light pole bases, flagpole bases, thrust blocks, and manholes.
5. Concrete curing.
6. Coordination with other sections:
   a. Make all preparations and do all work necessary to receive or adjoin other work. Install all bolts and anchors, including those furnished by other sections, into formwork and provide all required blocking.
   b. Install all accessories embedded in the concrete and provide all holes, blockouts and similar provisions necessary for the work of other sections. Provide all patching or cutting made necessary by failure or delay in complying with this requirement at the Contractor's expense.
   c. Coordinate with other sections for the accurate location of embedded accessories.

B. Related Sections:

1. Pertinent Sections of Division 01 specifying Quality Control and Testing Laboratory services.
2. Pertinent Sections of Division 03 specifying concrete construction.
3. Pertinent Sections of other Divisions specifying work to be embedded in concrete or work penetrating concrete.
4. Pertinent sections of other Divisions specifying floor finishes and sealants applied to concrete substrates.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC) Chapter 19A Concrete.

B. American Concrete Institute (ACI) PRC-211.1 “Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete”

C. ACI PRC-213 “Guide for Structural Lightweight-Aggregate Concrete”.

D. ACI SPEC-301 “Specifications for Concrete Construction”.

E. ACI PRC-302.1 “Guide for Concrete Floor and Slab Construction”.

F. ACI PRC-304 “Guide for Measuring, Mixing, Transporting, and Placing Concrete”.

G. ACI SPEC-305.1 “Specification for Hot Weather Concreting”.

H. ACI SPEC-306.1 “Standard Specification for Cold Weather Concreting”.

I. ACI SPEC-308.1 “Specification for Curing Concrete”.

J. ACI CODE-318 “Building Code Requirements for Structural Concrete and Commentary”.

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer. Submittals that do not meet these requirements will be returned for correction without review. Submit for review prior to fabrication.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents.

C. Product Data: Submit manufacturers' data on manufactured products and other concrete related materials such as bond breakers, cure/sealer, admixtures, etc. Demonstrate compliance with specified characteristics. Provide samples of items upon request. Submit material certificates for concrete aggregates and cementitious materials. Certificates shall show compliance to applicable ASTM’s, the CBC, and additional requirements stated herein.

D. Mix Designs: Submit Mix Designs for each structural concrete type required for work per requirements of articles CONCRETE MIXES and QUALITY ASSURANCE. Resubmit revised designs for review if original designs are adjusted or changed for any reason. Non-Structural mixes need not be submitted for review by Structural Engineer.

1. Provide an Environmental Product Declaration (EPD) specific to each mix design intended to be used. If an EPD is not available or cannot be provided, supplier shall provide a letter certifying that a mix-specific EPD is not available.

E. Shop Drawings: Proposed location of construction and cold joints. Proposed location of all slab construction/dowel joints, control joints, and blockouts.

F. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

G. Batch Plant Ticket: Include with delivery of each load of concrete. Provide ticket to the Testing Agency and the Architect/Engineer as separate submittals. Concrete delivered to the site without such ticket shall be rejected and returned to the plant. Each ticket shall include all information specified in Article SOURCE QUALITY CONTROL below.

H. Engineering Analysis: Prepared by a California-licensed Civil or Structural Engineer, justifying construction-imposed loads on slabs, beams, and walls which exceed those allowed by CBC for the specified use.

1. 2000 lbs maximum allowable construction load without analysis.
2. 10,000 lbs maximum allowable construction load with analysis.

I. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.4 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.

B. Concrete construction verification and inspection to conform to CBC 1705A.3.

C. Common Sourcing: Provide each of the following materials from consistent sources for entire project.

1. Cement.
2. Fly ash.
3. Aggregate.
4. Slag Cement.

D. Follow requirements of ACI SPEC-305.1 when concreting during hot weather. Follow requirements of ACI SPEC-306.1 when concreting during cold weather.

E. Services by the Independent Testing Agency (includes "Special" Inspections) as specified in this Section and as follows:

1. Perform tests and inspections specified below in articles SOURCE QUALITY CONTROL and FIELD QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs and reports to be in conformance with pertinent Sections of Division 01.

F. Contractor shall bear the entire cost of remediation, removal, and/or replacement of concrete determined defective or non-conforming, including Architect/Engineer fees for redesign.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Materials specified by brand name shall be delivered in unbroken packages bearing manufacturer's label and shall be brand specified or an approved equal.

B. Delivery, Handling and Storage of other materials shall conform to the applicable sections of the current editions of the various reference standards listed in this Section.

C. Protect materials from weather or other damage. Sort to prevent inclusion of foreign materials.

D. Specific Requirements:

1. Cement: Protect against dampness, contamination, and warehouse set. Store in weather tight enclosures.
2. Aggregates: Prevent excessive segregation, or contamination with other materials or other sizes of aggregates. Use only one supply source for each aggregate stock pile.
3. Admixtures:
   a. Store to prevent contamination, evaporation, or damage.
   b. Protect liquid admixtures from freezing and extreme temperature ranges.
   c. Agitate emulsions prior to use.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather (Freezing or near-freezing temperatures) per ACI SPEC-306.1:

1. Heat concrete materials before mixing, as necessary to deposit concrete at a temperature of at least 50°F but not more than 90°F.
2. Do not place concrete during freezing, near-freezing weather, snow, rain or sleet unless protection from moisture and/or cold is provided.

3. Protect from freezing and maintain at a temperature of at least 50°F for not less than seven days after placing. Take special precautions to protect transit-mixed concrete.
4. No salts, chemical protection or admixture are permitted without written approval of Architect/Engineer.
5. Contractor shall maintain an air temperature log for the first 7 days after placement with entry intervals not to exceed 8 hours.

B. Hot Weather per ACI SPEC-305.1:

1. Cool concrete materials before mixing, or add ice in lieu of mix water as necessary to deposit concrete at a temperature below 85°F.
2. Do not place concrete in hot/windy weather without Architect/ Engineer review of procedures.
3. Provide sunshades and/or wind breakers to protect concrete during finishing and immediate curing operations. Do not place slab concrete at air temperature exceeding 90°F.
4. Provide modified mix designs, adding retarders to improve initial set times and applying evaporation reducers during hot/windy weather for review by Independent Testing Agency prior to use.

1.7 MOCK-UP

A. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish, as result of formwork.

1. Panel Size: Sufficient to illustrate full range of treatment.
2. Number of Panels: 2.
3. Locate as indicated on drawings.

B. If requested by Architect / Engineer, cast concrete against mock-up panel. Obtain acceptance of resulting surface finish prior to erecting formwork.

C. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

D. Mock-up may remain as part of the Work.

1.8 SCHEDULING AND SEQUENCING

A. Organize the work and employ shop and field crew(s) of sufficient size to minimize inspections by the Testing Agency.

B. Provide schedule and sequence information to Testing Agency in writing upon request. Update information as work progresses.

PART 2 – PRODUCTS

2.1 FORMWORK

A. Comply with requirements of Section 03 1000.

2.2 REINFORCEMENT

A. Comply with requirements of Section 03 2000.

2.3 MATERIALS

A. General Requirements: All materials shall be new and best of their class or kind. All materials found defective, unsuitable, or not as specified, will be condemned and promptly removed from the premises.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type II, low alkali.
2. Fly Ash (Pozzolan): ASTM C618, Class F.
3. Slag Cement: ASTM C989, Grade 100 or 120.

C. Concrete Aggregates:

1. Coarse and Fine Aggregates: ASTM C33; Stone aggregate and sand. Specific source aggregate and/or sand or shrinkage characteristics as required for class of concrete specified.
2. Lightweight aggregate: ASTM C330 and C332.
3. Source shall remain constant throughout the duration of the job. The exact portions of the fine aggregates and coarse aggregates to be used in the mix shall be determined by the mix design.
4. Aggregates shall be tested for alkali reactivity per CBC section 1903A.5. Where test results exceed allowable limits, additional testing of mitigation procedures shall be provided, as outlined per CBC section 1903A.5.
5. Recycled concrete products: Returned plastic concrete may not be used in a mix. Recycled Concrete Aggregate (RCA) is not permitted. Reclaimed coarse aggregate is permitted and shall comply with ASTM C33. Reclaimed fine aggregate is not permitted.

D. Water: ASTM C1602. Potable, clean, from domestic source. Where non-potable water is intended to be used, provide additional testing data demonstrating compliance with ASTM C1602. Non-potable water shall not be used without the approval of the Architect/Engineer.

E. Admixtures: All admixtures shall be used in strict accordance with the manufacturer's recommendations. Admixtures containing calcium chlorides or other accelerators shall not be used without the approval of the Architect/Engineer and the Owner's Testing Laboratory.

1. Normal or Mid Range Water Reducing Admixtures: ASTM C494 Type A, “MasterPozzolith” series or "MasterPolyheed" series by Master Builders Solutions, "WRDA" series by W.R. Grace, or equal.
2. Water Reducing Admixture and Retarder: ASTM C494 Type B or D, "MasterSet R” series or “MasterSet DELVO” series by Master Builders Solutions, "Plastiflow-R" by Nox-crete, or equal.
3. High Range Water-Reducing Admixtures: ASTM C494 Type F, "MasterRheoBuild 1000" or “MasterGlenium” series by Master Builders Solutions or equal.
4. Air Entraining Admixtures: ASTM C260, “MasterAir” series by Master Builders Solutions or equal.
5. Viscosity Modifiers: ASTM C494 Type S, “MasterMatrix VMA” series by Master Builders Solutions or equal..

F. Slurry: Same proportion of cement to fine aggregates used in the regular concrete mix (i.e. only coarse aggregate omitted); well mixed with water to produce a thick consistency.

G. High Strength Grout: See section 05 1200 or 05 1100 for requirements.

H. Dry Pack: Dry pack (used only for cosmetic concrete repairs) shall consist of:

1. One part cement to 2-1/2 parts fine aggregate (screen out all materials retained on No.4 sieve), mixed with a minimum amount of water, added in small amounts.
2. Mix to consistency such that a ball of the mixture compressed in the hand will retain its shape, showing finger marks, but without showing any surface water.

2.4 ACCESSORIES

A. Bonding Agent: ASTM C881, Type II Grade 2 Class B or C. Do not allow epoxy to set before placing fresh concrete.

1. “MasterEmaco ADH 326” by Master Builders Solutions;
2. “Rezi-Weld 1000” by W.R. Meadows.

B. Chemical Hardener: Fluorosilicate solution designed for densification of cured concrete slabs. “MasterKure HD 300 WB” by Master Builders Solutions, "LIQUI-HARD" W.R. Meadows Co, or equal.

C. Moisture-Retaining Cover: ASTM C171, type 1, one of the following;

1. Regular Curing Paper, Type I, reinforced waterproof: Fortifiber Corporation "Orange Label Sisalkraft", "Pabcotite" paper, or equal.
2. Polyethylene Film: ASTM D2103, 4 mil thick, clear or white color.
3. White-burlap-polyethylene sheet, weighing not less than 10 oz/per linear yd.

D. Liquid Curing Compound: ASTM C309, Type 1, Class B, clear or translucent, 25% minimum solids, water base acrylic cure/sealer which will not discolor concrete and compatible with bonding of finishes specified in related sections. W.R. Meadows Co. “Vocomp 25” or equal. Maximum VOC content shall comply with local requirements and California Green Building Code.

E. Under Slab Water Vapor Retarder: Vapor retarder sheet to be ASTM E1745 Class A; 15 mil, single ply extruded polyolefin; permeance no greater than 0.01 U.S. Perms per ASTM E154, ASTM E96 procedure B or ASTM F1249.

1. “Stego Wrap Vapor Barrier (15mil)” by Stego Industries LLC.
2. “Vaporguard” by Reef Industries.
3. Approved Equal.

F. Evaporation Reducer: "MasterKure ER 50”, by Master Builders Solutions.

G. Permeability Reducer: Use only where specifically referred to.

1. ASTMC494 Type S.
2. Admixture Type: Xypex Chemical Corporation "XYPEX Admix C-500", Master Builders Solutions “MasterLife 300” series. Dosage: per manufacturer.
3. Surface-Applied Type: Xypex Chemical Corporation "XYPEX Concentrate. Brush application: 1.25-1.50lb/sq. yd., 5 parts powder to 2 parts water. Master Builders Solutions “MasterSeal 500”. Slurry coat: one part water to 2.25-2.5 parts powder by volume.
4. Approved equal.

2.5 JOINT DEVICES AND MATERIALS

A. Waterstops: Resilient type, meeting Corps of Engineers CRD-C 572. Consult manufacturer for appropriate product for specific use. Submit for review. Install per

manufacturers recommendation. Provide W. R. Meadows “Seal Tight” PVC waterstop, Sika “Greenstreak” PVC waterstop, or approved equal.

B. Expansion Joint Filler: ASTM D1751, Nonextruding, resilient asphalt impregnated fiberboard or felt, 3/8 inch thick and 4 inches deep; tongue and groove profile.

1. Products: "Serviced Products", W.R. Meadows, Inc., "National Expansion Joint Company", "Celotex Corporation", or equal.

C. Joint Filler: ASTM D994, Compressible asphalt mastic with felt facers, 1/4 inch thick and 4 inches deep.

D. Sealant and Primer: As specified in Section 07 9000.

E. Slab Joint Sealant: Compatible with floor finishes specified in related sections.

2.6 CONCRETE MIXES

A. General requirements for mix design and submittal of structural class concrete:

1. Provide Contractor submittals to Architect/Engineer not less than 15 days before placing concrete.
2. Contractor shall review mix designs and proposed placing requirements prior to submittal for compatibility to ensure that the concrete as designed can be placed in accordance with the drawings and specifications.
3. Changes or revisions require re-submittal: All variations to approved mix designs, including changing type and/or quantity of admixtures shall be resubmitted to the Architect/Engineer for review prior to use.
4. Mix design(s) for all structural classes of concrete to be prepared by qualified person experienced in mix design. Allow for time necessary to do trial batch testing when required.
5. Preparer to provide backup data and certify in writing that mix design meets:
   a. Requirements of the specifications for concrete durability and quality;
   b. Requirements of the California Building Code and ACI SPEC-301, including break histories, trial batching test results, and/or a mix designed by a California Registered Civil Engineer per ACI CODE-318 and bearing the Engineer’s seal & signature.
6. Clearly note on mix designs with specified maximum W/CM if design permits addition of water on site, or clearly identify in the mix design that no water is to be added on site.
7. Deviations: Clearly indicate proposed deviations, and provide written explanation explaining how the deviating mix design(s) will provide equivalent or better concrete product(s) than those specified.
8. Include adjustments to reviewed mix designs to account for weather conditions and similar factors.

B. Proportioning - General: The following provisions apply to all mix designs:

1. Proportion concrete mixes to produce concrete of required average strength (as defined by ACI CODE-318). Select slump, aggregate sizes, shrinkage, and consistency that will allow thorough compaction without excessive puddling, spading, or vibration, and without permitting the materials to segregate, or allow free water to collect on the surface.
2. Select aggregate size and type to produce dense, uniform concrete with low to moderate shrinkage, free from rock pockets, honeycomb and other irregularities.

3. Mix designs may include water reducing and retarding admixtures to meet or exceed minimum set times (time required to place and finish) and to minimize Water-Cementitious Materials (W/CM). Minimum and maximum criteria presented in this section are guidelines and do not represent a specific mix design.
4. Cement Content: Minimum cement content indicates minimum sacks of cementitious material. Increasing cement content to increase early strengths or to achieve specified W/CM while maintaining water content is discouraged in order to minimize effects of shrinkage.
    a. Substitution of fly ash for Portland cement on an equivalent weight basis up to 25% replacement is permitted, except at high early strength concrete. Replacement in excess of 25% is not permitted unless part of a specified mix design that has been submitted for review.
    b. Substitution of slag cement for Portland cement on an equivalent weight basis up to 45% replacement is permitted, except at high early strength concrete. Replacement in excess of 45% is not permitted unless part of a specified mix design that has been submitted for review.
    c. Such substitution requests may be denied by the Engineer.
5. Water Content: Mix designs with a specified maximum W/CM may be designed with a lower WCR than specified in order to allow addition of water at the site.
6. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301 and this section.
    a. For trial mixtures method, employ independent testing agency acceptable to Architect/Engineer for preparing and reporting proposed mix designs.
7. Placement Options: Mix designs may, at the Contractor's option, be designed for either pump or conventional placement with aggregate size, slumps, etc. to be maintained as specified in this section.

C. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations and this section.

D. Special mix design requirements for interior concrete floor slabs-on-ground:

1. Proportion concrete mixes per this specification, ACI PRC-211.1, and the requirements below:
2. Fly Ash, shall be substituted for cement on a 1 lb. per 1 lb. basis, with a minimum replacement of 25% and a maximum of 35%. Alternatively, slag cement, shall be substituted for cement on a 1 lb. per 1 lb. basis, with a minimum replacement of 30% and a maximum of 45%.
3. 200 lbs. of 3/8(-) aggregate shall be added to reduce total sand.
4. Reduce total sand to minimum practical.
5. Admixture dosage shall be per manufacturer’s recommendations. Dosage may be increased for workability as long as set times are not excessive for placement and finishing.

E. Proportioning Structural Light Weight Concrete: Comply with ACI PRC-213 recommendations and this section. Maximum cured weight of light weight concrete shall be 120 pounds per cubic feet. General Contractor is responsible for coordinating and providing light weight concrete density to meet the required fire assembly rating of the Construction Documents at the concrete depths provided in the structural drawings. General Contractor to notify the Structural Engineer for review if light weight concrete of the required density for the specified fire assembly rating cannot be sourced.

F. Special mix design requirements for high volume fly ash concrete:

1. Proportion concrete mixes per this specification, ACI PRC-211.1, and the requirements below:
2. Fly Ash shall be substituted for cement on a 1 lb. per 1 lb. basis, with a replacement of 50%.
3. Minimum strength at 28 days to be 2500 psi; minimum strength at 56 days to be 3000 psi.
4. Add 200-300 pounds 3/8” aggregate to replace portion of fine aggregate.
5. Admixture dosage shall be per manufacturer’s recommendations. Dosage may be increased for workability as long as set times are not excessive for placement and finishing.
6. Concrete shall be wet cured per CONCRETE CURING.

Mix Design Minimum Requirements:

Concrete Class	Coarse Aggregate Size (Inches) & Fine Aggregate[3]	Maximum W/CM or Maximum Nominal Slump & Tolerance (Inches)[1,2]	Minimum 28-Day Design Strength	Minimum Cement Sacks/per yd[4]
NON-STRUCTURAL				
1) Lean Concrete (use only where specified)	---	---	---	3.0
2) Exterior Slab on Ground (Walkways & Patios)	1" x #4	W/CM = .55	2,500	4.5
STRUCTURAL				
3) Interior Slab on Ground[5]	1" x #4	W/CM = .45	3,000	6.1
4) Foundation (including continuous footings, pad footings, grade beams, stem walls)	1" x #4	W/CM = .53	3,000	5.0
5) Cast Slab Above Grade on Metal Deck	3/4" x #4	W/CM = .53	3,000	5.0
6) Formed Cast Slab Above Grade, Beams, Columns, Walls, Retaining Walls	1" x #4	W/CM = .46	4,000	6.0
7) Drilled Pier	3/4" x #4	W/CM = .53	3,000	5.0
8) Tilt-Up Concrete Wall Panels	1" x #4	W/CM = .53	3,000	5.25
9) Light Weight Concrete	3/8" x #4 Expanded Shale	3" ± 1/2"	3,000	5.5
10) High Volume Fly Ash Concrete[6]	1" x #4	W/CM = .45	See footnote 6	6.0

1. The tolerance is the maximum deviation allowable without rejection. The mix design shall be based on the nominal value specified and is without water reducing mixtures. Slump to be measured at the end of the hose.
2. The maximum W/CM is limited at time of placement as noted. No water is to be added on site such that the specified W/CM or maximum slump is exceeded without approval of the testing laboratory and the Architect/Engineer. Workability is to be achieved utilizing an acceptable mid range to high range water reducing admixture.
3. Gradation of aggregate is per ACI CODE-318 and ASTM C33.
4. Minimum cement content includes all cementitious materials.
5. See Article 2.6D for additional requirements at interior slabs on ground.
6. See article 2.6F for additional requirements at high volume fly ash concrete.

2.7 MIXING CONCRETE

A. Batch final proportions in accordance with approved mix designs. All adjustments to approved proportions, for whatever reason, shall be reviewed by the Architect/Engineer prior to use.

B. Batch and mix concrete in accordance with ASTM C94, at an established plant. Site mixed concrete will be rejected.

C. Provide batch and transit equipment adequate for the work. Operate as necessary to provide concrete complying with specified requirements.

D. Place mixed concrete in forms within 1-1/2 hours from the time of introduction of cement and water into mixer or 300 revolutions of the drum whichever comes first. Use of, re-mixing, and/or tempering mixed concrete older than 1 hour will not be permitted.

E. Do not add water at the site to concrete mixes with a maximum specified W/CM unless the water content at batch time provides for a W/CM less than specified and this provision, including the quantity of water which may be added at the site, is specifically noted on the mix design and certification by the mix preparer. See ASTM C94 for additional requirements.

2.8 SOURCE QUALITY CONTROL

A. Services by independent Testing Agency:

1. Where aggregate alkali reactivity testing (and, when applicable, mitigation testing) per the MATERIALS section is not available, the Testing Agency shall perform this testing to verify materials conformance to CBC section 1903A.5.
2. Batch Plant inspection at automated plants to occur at commencement of concrete work each day (first truck). Batch Plant inspection at non-automated plants and when accuracy is questionable shall be continuous. Additionally, water cement ratio (WCR) is to be verified where a WCR is specified herein. The computed WCR is to be written on the Batch Plant Certificate to be taken to the job site prior to the truck leaving the plant. See requirements of CBC 1705A.3.3.
3. Batch Plant Certificates: Obtain the weighmaster's Batch Plant Certificate at arrival of truck at the site. If no batch plant certificate is provided, recommend to the General Contractor that the truckload of concrete be rejected. So note in daily log, along with the location of the load of concrete in the structure if the load is not rejected. See requirements of CBC 1705A.3.3.
    a. Laboratory's inspector shall obtain for each transit mixer Batch Plant Certificates to verify mix design quantities and condition upon delivery to the site.
    b. Certificates to include: Date, time, ingredient quantities, water added at plant and on job, total mixer revolutions at time of placement, and time of departure.
    c. Concrete with specified water cement ratio: Add no water on site unless mix design and batch records each show additional water may be added. See ASTM C94 for additional requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

B. Verify work of other sections is complete and tested as required before proceeding.

3.2 PREPARATION

A. Observation, Inspection and Testing:

1. Architect/Engineer: Notify not less than 2 working days before each concrete placement, for observation and review of reinforcing, forms, and other work prior to placement of concrete.
2. Testing Agency: Notify not less than 24 hours before each placement for inspection and testing.

B. Placement Records: Contractor shall maintain records of time, temperature and date of concrete placement including mix design and location in the structure. Retain records

until completion of the contract. Make available for review by Testing Agency and Architect/Engineer.

C. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

D. Verify location, position and inclusion of all embedded and concealed items.

E. Verify installation of vapor retarder under interior slabs on ground, as specified in related section, is complete.

F. Cleaning and Preparation:

1. Remove loose dirt, mud, standing water, and foreign matter from excavations and cavities.
2. Close cleanout and inspection ports securely.
3. Thoroughly clean reinforcement and other embedded items free from loose rust and foreign matter. Maintain reinforcing securely in place. Do not place concrete on hot reinforcing.
4. At cold joints, remove laitance from previously placed concrete surface.
5. Dampen form materials and substrates on which concrete is to be placed at least 1 hour in advance of placing concrete; repeat wetting as necessary to keep surfaces damp. Do not saturate. Do not place concrete on saturated material.
   a. Thoroughly wet wood forms (except coated plywood), bottom and sides of trenches, adjacent concrete or masonry and reinforcement.
   b. Concrete slabs on base rock, dampen rock.
   c. Concrete slabs on vapor retarder, do not wet vapor retarder.
6. Verify that metal forms are clean and free of rust before applying release agent.
7. Thoroughly clean metal decking. Do not place concrete on wet deck surface.
8. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

G. Drill holes in existing concrete at locations where new concrete is doweled to existing work. Insert steel dowels and prepare connections as detailed.

H. Do not overcut at existing concrete work to remain. Contractor is responsible for repair/replacement of overcut concrete to the Owner’s satisfaction.

3.3 PIPES AND CONDUITS IN CONCRETE

A. Slabs-on-Ground:

1. No pipe or conduit exceeding 1 inch outside diameter shall be embedded within the specified slab thickness except as specifically detailed.
2. Do not stack or abut pipes, maintain 3 inches minimum clearance.

B. Sleeving and Wrapping:

1. Foundations: Sleeve or wrap all individual pipe penetrations, minimum 1-1/2 inches clear to reinforcing all around.
   a. Sleeves: PVC. Provide 1 inch minimum clear all around O.D. pipe to I.D sleeve, UNO at ends, fill void space with mastic or plastic bituminous cement.
   b. Wrapped Vertical Pipes: Provide 1/8 inch nominal sheet foam with three wraps minimum, UNO.
   c. Wrapped Horizontal Pipes: Provide 1/8 inch nominal sheet foam with eight wraps minimum, UNO.

d. Underground Fire Lines 4” and Larger: At sleeves provide 2 inch minimum clear all around O.D. pipe to I.D sleeve. At wrapped pipes, provide 1/8 inch nominal sheet foam with sixteen wraps minimum.

2. Slabs or Curbs: Wrap pipes as described above.

C. Space groups of pipes/conduits at least 3 sleeve diameters apart, do not interrupt specified concrete and reinforcement.

1. Provide block-outs as detailed when grouping of pipes/conduits in foundation or other structural member prevents spacing as described. Notify Architect/Engineer for review of any conditions not conforming to details.
2. Center pipe/conduit penetrations in the depth and/or thickness of foundations.
3. Maximum size of pipe/conduit penetrations shall not exceed the least dimension of concrete divided by 3.

D. Do not embed pipes/conduits in concrete slabs on metal deck.

E. Provide the following at pipes/conduits detailed to be embedded in a concrete beam, wall or column:

1. Place as near as possible to center of member with reinforcing as specified on each side.
2. Where reinforcing is located near or at center of member, place pipe or conduit 1 inch minimum clear from reinforcing and provide #3 at 12 inches on center perpendicular to the pipe/conduit. Reinforcing to extend 12 inches minimum past pipe/conduit each side.
3. Maintain ¾ inch clear minimum from added reinforcing to face of concrete where not exposed to weather and 1-1/2 inches clear where exposed to weather.
4. Space embedded items (groups of pipe/conduit, junction boxes or other elements) minimum 3 inches apart.
5. Provide reinforcing in walls, beams, columns as detailed for groups of pipe/conduit. Provide minimum replacement reinforcement of same size and number for interrupted or displaced reinforcement for the full height, length, width of the wall, beam, and/or column on each side of the “effective opening.”

3.4 CONCRETE PLACEMENT

A. Transporting:

1. Provide clean, well-maintained equipment of sufficient quantity and capacity to execute the work and produce concrete of quality specified.
2. Handle and transport concrete from mixer to final deposit location as rapidly as practicable. Prevent separation or loss of ingredients.

B. Perform concrete placement by methods which will not puncture, damage or disturb vapor retarder membrane. Repair all damage to vapor retarder membrane before covering.

C. Placement - General: Placement, once started, shall be carried on as a continuous operation until section of approved size and shape is completed. Provide construction joints as detailed on the drawings. Engineer's written approval required for all deviations.

1. Deposition:
   a. Deposit concrete to maintain an approximately horizontal plastic surface until the completion of the unit placement.
   b. Deposit as neatly as practicable in final position, minimize re-handling or flow.

c. Do not drop concrete freely where reinforcing bars, embeds, or obstructions occur that may cause segregation. Provide spouts, elephant trunks, or other means to prevent segregation during placement.

2. Depth: Layered placement in columns and walls shall not exceed ten feet vertical depth.
   a. Place concrete in minimum 32 inch horizontal lifts.
   b. Schedule placement to ensure that concrete will not take initial set before placement of next lift.
   c. No horizontal cold joints are allowed in columns or walls.
3. Progress Cleaning: Remove all concrete spilled on forms or reinforcing steel in portions of structure not immediately concreted. Remove completely before concrete sets.
4. Interruptions: Shut down placement operations and dispose of all remaining mixed concrete and concrete in hoppers or mixers following all interruption in placement longer than 60 minutes.
   a. If such interruption occurs, provide new or relocate existing construction joints as directed by Engineer.
   b. Cut concrete back to the designated line, cleaning forms and reinforcing as herein specified.
   c. Prepare for resumption of placement as for new unit when reason for interruption is resolved.

D. Placement - Elevated Structural Systems: Place as noted for "General" above and as follows:

1. Metal Decking and Structural Steel Beam Systems that are not to be shored: Locate screed lines on primary structural members. Review proposed screed line locations and expected structural deflections with the Architect/Engineer prior to placement of concrete.
2. Place screed lines to match camber of primary girders made of material other than concrete. Locate screeds to provide the minimum specified thickness of concrete at all locations.
3. Compensate for deflection of intermediate structural members and decking by placement of additional concrete.
4. Adjust embedded items to compensate for camber and deflection. Maintain locations within specified tolerances.

E. Consolidation:

1. Consolidate all concrete thoroughly during placement with high-speed mechanical vibrators and other suitable tools. Perform manual spading and tamping to work around reinforcement, embedded fixtures, and into corners of formwork as required to obtain thorough compaction.
   a. Provide vibrators with sufficient amplitude for adequate consolidation.
   b. Use mechanical vibrators at each point of concrete placement.
   c. Keep additional spare vibrators, in addition to those required for use, at the site for standby service in case of equipment failure.
2. Consolidate each layer of concrete as placed.
   a. Insert vibrators vertically at points 18 to 30 inches apart; work into top area of previously placed layer to reconsolidate, slowly withdraw vibrator to surface.
   b. Avoid contact of vibrator heads with formwork surfaces.
   c. Systematically double back and reconsolidate wherever possible. Consolidate as required to provide concrete of maximum density with minimized honeycomb.

F. Unacceptable Materials:

1. Do not place concrete that has started to set or stiffen. Dispose of these materials.
2. Do not add water on site to concrete except as specified in the approved mix design, see PART 2 above.

G. Protection of installed work:

1. Do not introduce any foreign material into any specified drainage, piping or duct systems.
2. Contractor shall bear all costs of work required to repair or clean affected work as a result of failure to comply with this requirement.

3.5 CONCRETE JOINTS

A. Structural Joints (Construction/Cold Joints):

1. Locate joints only where shown, or as approved.
2. Review Required: Joints not indicated on the plans shall be located to meet the minimum requirements below, shall not impair the strength of the structure and shall be submitted to Architect/Engineer for review prior to placement of concrete.
   a. Indicate proposed location(s) of construction/cold/expansion joints on shop drawing submittals for review prior to placing concrete.
3. Clean and roughen all surfaces of previously placed concrete at construction joints by washing and sandblasting to expose aggregate to 1/4 inch amplitude.
4. Slabs-On-Ground: Maximum Length of continuous placement shall not exceed 60 feet without special review by the Architect/Engineer. Alternate or stagger placement sections.
5. Foundations, Beams, Elevated Slabs and Joists: Maximum Length of continuous placement shall not exceed 200 foot increments. Provide “keyed” shut-off locations made up with form boards. Extend reinforcing one lap length or more through shut-off.
   a. All reinforcement shall be continuous through construction/cold joint, lapping to adjacent reinforcing in future placement.
   b. Construction Joints in Elevated Slabs: Review all proposed locations with Architect/Engineer.
   c. Construction Joints in Slabs on Metal Decking: Review all proposed locations with Architect/Engineer. Do not locate closer than 48 inches of centerline of beam.
6. Retaining and Basement Walls: Maximum Length of continuous placement shall not exceed 100 foot increments. Provide “keyed” shut-off locations made up with form boards to limit the length of continuous placement and at abrupt changes in wall thickness. Extend reinforcing one lap length or more through shut-off.
   a. Review all proposed locations with Architect/Engineer
   b. Horizontal construction joints are not allowed unless approved by the Engineer
7. Horizontal Construction Joints: Place 2 inch slurry (specified concrete mix less coarse aggregate) at beginning of pour at the bottom of walls unless a prior review of a mock-up section demonstrates that segregation of aggregate will not occur.

B. Expansion/Construction Joints (Dowel Joints and Control Joints):

1. Interior and Exterior Slabs-on-Ground:

a. Expansion/Construction Joints: Provide dowel joints or control joints at a maximum dimension (in feet) of three times the slab thickness (in inches) in each direction unless noted otherwise (15'-0" maximum). Install joints to match slab level and in straight lines. Locate joints at all reentrant corners including blockouts.
b. Proportions: Install joints to divide slab into rectangular areas with long dimensions less than 1.5 times short dimension.

2. Exterior Concrete Slabs-on-Ground (walkways, patios):
a. Expansion/ construction joints: Provide a 2 inch deep troweled groove or asphalt impregnated joint material embedded 50 percent of the slab depth at 12 feet on center, maximum.
b. Proportions: Place no section with a length larger than two times width. Additionally, place joints at all inside corners and at all intersections with other work.

3. Elevated Structural Slabs: Locate construction joints as specifically indicated on the drawings. All additional proposed locations shall be reviewed by the Architect/Engineer prior to placement.

4. Retaining and Basement Walls:
a. Contraction Joints: Provide ¾ inch wide beveled wood strips attached to inside face of formwork on each side of the wall. Wood strips shall extend 1/8 times the wall thickness into the wall. Cut 50% of the horizontal reinforcing bars at contraction joint locations
b. Proportions: Place joints at 2 times the height of the wall on center max, but not less than 10'-0". Joints shall not exceed 25'-0" on center.
c. Review all proposed locations with Architect/Engineer

C. Joint Types:

1. Dowel Joint: A keyed joint with smooth dowels passing through to allow unrestricted movement due to contraction and expansion. Joints are as specified on the drawings.
2. Control Joint(s): Shrinkage crack control joints may be of the following types when shown on the drawings. Install joints in a straight line between end points with edges finished appropriate to type. Depth shall be 25% of the slab thickness, unless noted otherwise. Fill joints with sealant as shown on the drawings or as required by related sections.
a. 1/4 inch wide troweled joint.
b. Keyed joint: Only at locations where concealed by other finishes.
c. Masonite Strip, 1/8 inch: Only at locations where concealed by other finishes.
d. Saw Cut, 1/8 inch: Must be performed within eight hours of completion of finishing. Do not make saw cuts if aggregate separates from cement paste during cutting operation. Prevent marring of surface finish. Fill with flexible sealant.

3.6 VAPOR RETARDER

A. Vapor Retarder Installation: Install as specified in PART 2, ASTM E1643, and per manufacturer's recommendations including taping and lapping of seams, sealing of penetrations, and repair of damage. Do not extend vapor retarder below footings.

3.7 FLATWORK

A. General Requirements for All Concrete Formed & Finished Flat:

1. Edge Forms and Screeds: Set accurately to produce indicated design elevations and contours in the finished surface, edge forms sufficiently strong to support screed type proposed.
2. Jointing: Located and detailed as indicated.
3. Consolidation: Concrete in slabs shall be thoroughly consolidated.

B. Flatwork Schedule:

1. Exterior Slabs-On- Ground: Place concrete directly over sub-base as indicated.
   a. Sub-Base: Clean free-draining, crushed base rock, 4 inch minimum thickness, thoroughly compacted.
2. Interior Concrete Slabs-On- Ground:
   a. Sub-Base: Clean free-draining, crushed base rock, 4 inch minimum thickness, thoroughly compacted.
   b. Vapor Retarder: Install over sub-base.

3.8 FORMED SURFACES

A. Form all concrete members level and plumb, except as specifically indicated. Comply with tolerances specified in ACI CODE-318, ACI SPEC-301, and this specification, except that maximum permissible deviation is 1/4 inch end-to-end for any single member.

B. Cambers: Provide all cambers indicated in the formwork construction. Set screeds to produce specified cambers in the finished concrete.

3.9 CONCRETE FINISHES

A. Flatwork Finishing:

1. Perform with experienced operators.
2. Finish surfaces monolithically. Establish uniform slopes or level grades as indicated. Maintain full design thickness.
3. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains as indicated on drawings.
4. Flatwork Finish Types:
   a. Wood Float Finish: Surfaces to receive quarry tile, ceramic tile, or cementitious terrazzo with full bed setting system, or wood frame for raised finished floors.
   b. Steel Trowel Finish: Surfaces to receive carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set tile or similar finishes specified in related sections. Trowel twice, minimum.
   c. Slip-Resistant Broom Texture Finish: Exterior surfaces as indicated or for which no other finish is indicated. Finish as for steel trowel finish, except immediately following first troweling, (depending on conditions of concrete and nature of finish required) provide uniform surfaces texture using a medium or coarse fiber broom applied perpendicular to the path of travel.

B. Other Concrete: Provide as required to achieve appearance indicated on structural and architectural drawings and related sections.

1. Repair surface defects, including tie holes, immediately after removing formwork.
2. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
3. Exposed Form Finish: Finish concrete to match forms. Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:

a. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
b. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.
c. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float; compress grout with low-speed grinder, and apply final texture with cork float.

4. Intermediate joint and score marks and edges: Tool smooth and flush unless otherwise indicated or as directed by the Architect.
5. Use steel tools of standard patterns and as required to achieve details shown or specified. All exposed corners not specified to be chamfered shall have radiused edges.

3.10 TOLERANCES

A. Minimum Flatwork Tolerances: Measure flatness of slabs with in 48 hours after slab installation in accordance with ACI PRC-302.1 and ASTM E1155 and to achieve the following FF and FL tolerances:

1. Exterior surfaces: 1/8 inch minimum per foot where sloped to drain. Level otherwise. FF20 and FL15.
2. Interior surfaces not otherwise shown or required: Level throughout. FF25 and FL20
3. Interior surfaces required to be sloped for drainage: 1/8 inch in 10 ft.
4. Finish concrete to achieve the following tolerances:
   a. Under Glazed Tile on Setting Bed: FF30 and FL20.
   b. Under Resilient Finishes: FF35 and FL25.
   c. Flooring manufactureer and pertainent section of Division 9.

B. Formed Surface Tolerances:

1. Permanently Exposed Joints and Surfaces: Provide maximum differential height within two feet of, and across construction joints of 1/16 inch.
2. Vertical Elevations: Elevation of surfaces shall be as shown or approved.

3.11 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required dividers, edge strips, reinforcing, and other items to be cast in.

C. Apply bonding agent to substrate in accordance with manufacturer's instructions.

D. Apply sand and cement slurry coat on base course, immediately prior to placing toppings.

E. Place concrete floor toppings to required lines and levels. Place topping in checkerboard panels not to exceed 20 feet in either direction.

F. Screed toppings level, maintaining surface tolerances per above.

3.12 CONCRETE CURING

A. Curing - General: Cure in accordance with ACI SPEC-308.1. Maintain concrete water content for proper hydration and minimize temperature variations. Begin curing immediately following finishing.

B. Protection During Curing: Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. The General Contractor is responsible for the protection of the finished slab from damage.

1. Avoid foot traffic on concrete for minimum of 24-hours after placement.
2. Protect concrete from sun and rain.
3. Maintain concrete temperature at or above 50 degrees F. during the first 7 days after placement. See Article ENVIRONMENTAL REQUIREMENTS.
4. Do not subject concrete to design loads until concrete is completely cured, and until concrete has attained its full specified 28-day compressive strength or until 14 days after placement, whichever is longer.
5. Protect concrete during and after curing from damage during subsequent building construction operations. See Article PROTECTION.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Normal concrete: Not less than 7 days.
2. High early strength concrete: Not less than 4 days.

D. Begin curing immediately following finishing.

E. Surfaces Not in Contact with Forms:

1. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than 3 days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
2. Begin final curing after initial curing but before surface is dry.
   a. Moisture-retaining cover: Seal in place with waterproof tape or adhesive.
   b. Curing compound: Apply in two coats at right angles, using application rate recommended by manufacturer.
3. In addition, see specific conditions noted below.

F. Slabs on Ground: Cure by one of the following methods:

1. Water Cure (Ponding): Maintain 100 percent coverage of water over floor slab areas, continuously for minimum 7 calendar days.
2. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
3. Moisture-Retaining Film or Paper: Lap strips not less than 6 inches and seal with waterproof tape or adhesive; extend beyond slab or paving perimeters minimum 6 inches and secure at edges; maintain in place for minimum 7 days.
4. Absorptive Moisture-Retaining Covering: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides and extend beyond slab or paving perimeters 6 inches minimum; maintain in place for minimum 7 days.
5. Liquid Membrane-forming Curing Compound: Provide only when subsequent concrete treatments or finish flooring specified in related sections will not be affected by cure/sealer. Apply curing compound in accordance with manufacturer's instructions at the maximum recommended application rate in two coats, with second coat applied at right angles to first.

G. Elevated Slabs: Cure by one of the following methods.

1. Moisture-Retaining Sheet: As specified for Slab on Ground above.
2. Water Cure: As specified above for minimum 14 days.
3. Apply Membrane Curing Compound as specified above after initial curing period.

H. Concrete on Metal Decking: Moisture-Retaining Sheet method as specified above.

I. Formed Concrete Members: Cure by moist curing with forms in place for full curing period.

1. Protect free-standing elements from temperature extremes.
2. Maintain forms tight for minimum 7 days. Maintain exposed surfaces continuously damp and completely covered by sheet materials thereafter.
3. Maintain all shoring in place. Refer to related sections specifying formwork.
4. Membrane Curing Compound: Apply compound in accordance with manufacturer's instructions in one coat.

J. Foundations: Apply curing compound immediately after floating.

3.13 CONCRETE HARDENER

A. Apply hardener to all floor slabs not receiving other finishes after 30 days minimum curing. Clean slabs of non-compatible cure/sealers or other foreign material(s) and apply in strict accordance with the manufacturer's directions.

3.14 GROUTING AND DRY PACK

A. Set steel plates on concrete or masonry with high strength grout bed, completely fill all voids; thoroughly compact in place. See Section 05 1200 or 05 1100.

B. Bolts or inserts dry packed or grouted in place shall cure for minimum 7 days before tensioning.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspections by Independent Testing Agency: Provided verification and inspection of concrete per CBC Table 1705A.3. Provide written reports for to Engineer, Architect, Contractor and Building Official for the following tests and inspections:

B. Testing & Inspection: Provide periodic inspection of reinforcing steel. Provide continuous inspection during placement of structural class concrete, 3000 psi or more. Non-structural class concrete with a design strength of 2500 psi or less to have periodic inspection on a 150 cubic yard basis as required to assure conformance.
1. Provide periodic inspection of bolts in concrete prior to and during placement where so noted on the construction documents.
2. Structural Concrete Cylinder Tests: Form in accordance with ASTM C31.
   a. Take four standard 6 inch x 12 inch (or five 4 inch x 8 inch) cylinder specimens on the site, of each class of concrete as specified in PART 2, not less than once a day or for each 150 cubic yards or 5000 sq ft or fraction thereof placed each day.
   b. Record the location of each concrete batch in the building in a log and also note on each specimen.
   c. Perform standard compression test of cylinders in accordance with ASTM C39, one at 7 days and two (three for 4x8 cylinders) at 28 days.
   d. Hold fourth (fifth) cylinder untested until specified concrete strengths are attained.
3. Structural Concrete Slump Test and Air Tests: Perform slump in accordance with ASTM C143 and air content in accordance with ASTM C231 or C173 at the time of taking test cylinders, and/or at one-hour intervals during concrete placing.
4. Measure and record concrete temperature in accordance with ASTM C1064 upon arrival of transit mixers and when taking specimens. Note weather conditions and temperature.

5. Determine concrete density in accordance with ASTM C138 at the time of forming test cylinders.
6. Propose adjustments to reviewed mix designs for Architect / Engineer review to account for variations in site or weather conditions, or other factors as appropriate.
7. Water Vapor Transmission Tests: Floors receiving floor finishes specified in related sections will be tested prior to installation of flooring systems. Refer to sections specifying floor finishes for related requirements.

C. Services by Contractor:

1. Rejection of Concrete Materials: Do not use the following without prior written approval of the Architect/Engineer;
   a. Materials without batch plant certificates.
   b. Materials not conforming to the requirements of these specifications.

3.16 ADJUSTING

A. Inspect all concrete surfaces immediately upon formwork removal. Notify Architect/Engineer of identified minor defects. Repair all minor defects as directed.

B. Surface and Finish Defects: Repair as directed by the Architect/Engineer, at no added expense to the Owner. Repairs include all necessary materials; reinforcement grouts, dry pack, admixtures, epoxy and aggregates to perform required repair.

1. Repair minor defective surface defects by use of drypack and surface grinding. Specific written approval of Architect/Engineer is required. Submit proposed patching mixture and methods for approval prior to commencing work.
2. Slabs-on- Ground, Elevated Slabs and on Slabs on Metal Deck: Review for "curled" slab edges and shrinkage cracks prior to installation of other floor finishes. Grind curled edges flush, fill cracks of 1/16 inch and greater with cementitious grout.
3. Grind high spots, fins or protrusions caused by formwork; Fill-in pour joints, voids, rock pockets, tie holes and other void not impairing structural strength. Provide surfaces flush with surrounding concrete.

3.17 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required compressive strength, lines, details, dimensions, tolerances, finishes or specified requirements; as determined by the Architect/Engineer.

B. Repair or replacement of defective concrete will be determined by the Architect/Engineer who may order additional testing and inspection at his option. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Specific Defects:

1. "Low-Strength"; Concrete Not Meeting Specified Compressive Strength after 28 days:
   a. Concrete with less than 25% Fly Ash or 35% Slag as cementitious material: Test remaining cylinder(s) at 56 days. If strength requirements are met, concrete strength is acceptable.
   b. Concrete with 25% or more Fly Ash or 35% or more Slag as cementitious material: Test remaining cylinder(s) at 70 days. If strength requirements are met, concrete strength is acceptable.

2. Excessive Shrinkage, Cracking, Crazing or Curling; Defective Finish: Remove and replace if repair to acceptable condition is not feasible.
3. Lines, Details, Dimensions, Tolerances: Remove and replace if repair to acceptable condition is not feasible.
4. Slab sections not meeting specified tolerances for trueness/flatness or lines/levels: Remove and replace unless otherwise directed by the Architect/Engineer. Minimum area for removal: Fifteen square feet area unless directed otherwise by the Architect/Engineer.
5. Defective work affecting the strength of the structure or the appearance: Complete removal and replacement of defective concrete, as directed by the Architect/Engineer.

3.18 CLEANING

A. Maintain site free of debris and rubbish. Remove all materials and apparatus from the premises and streets at completion of work. Remove all drippings; leave the entire work clean and free of debris.

B. Slabs to Receive Floor Finishes Specified in other sections: Remove non-compatible cure/sealers or other foreign material(s) which may affect bonding of subsequent finishes. Leave in condition to receive work of related sections.

3.19 PROTECTION

A. Protect completed work from damage until project is complete and accepted by Owner.

B. Construction Loads: Submit engineering analysis for equipment loads (including all carried loads) specified in article submittals.

C. Keep finished areas free from all equipment traffic for a minimum of 4 additional days following attainment of design strength and completion of curing.

D. Protection of Drainage Systems:

1. Care shall be taken not to introduce any foreign material into any specified drainage, piping or duct system.
2. Cost of work to repair or clean drainage system as a result of failure to comply with this requirement will be back charged to the contractor.

E. Cover traffic areas with plywood sheets or other protective devices; maintain protection in place and in good repair for as long as necessary to protect against damage by subsequent construction operations.

END OF SECTION 03 30 00

SECTION 05 11 00

STRUCTURAL AND MISCELLANEOUS STEEL

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: All labor, materials, equipment and operations required to complete structural and miscellaneous metals in shapes and configurations indicated; including:

1. Structural steel columns, beams, bracing, base plates, bolts, joist hangers, and stud bolts welded to structural steel.
2. Miscellaneous structural steel and connections; fabricated connectors and hangers installed by related sections.
3. Anchor bolts and steel inserts embedded in concrete or masonry, installed by related sections.
4. Fabricated steel items embedded in concrete or masonry installed by related sections.
5. Supervision of anchor bolt setting, leveling and elevations to ensure required fit of steel work.
6. Shop priming and field touch-up, galvanizing.
7. Bracing, Shoring, Fabrication and Erection.

B. Related Sections:

1. Pertinent sections of Division 01 specifying Quality Control and Testing Agency services.
2. Pertinent Sections of other Divisions specifying concrete reinforcement, formwork, concrete, structural and miscellaneous metal fabrications, steel joists, metal decking, cold-formed metal framing, rough carpentry.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 22A Steel.

B. American Institute of Steel Construction (AISC) 303 “Code of Standard Practice for Steel Buildings and Bridges”.

C. AISC 360 “Specification for Structural Steel Buildings”.

D. American Welding Society (AWS) D1.1 “Structural Welding Code - Steel”.

E. Underwriters Laboratories (UL) FRD “Fire Resistance Directory”.

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer. Submittals that do not meet these requirements will be returned for correction without review.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents.

C. Product Data: Submit manufacturer's product data, specifications, location and installation instructions for proprietary materials and reinforcement accessories. Provide samples of these items upon request.

1. Provide an Environmental Product Declaration (EPD). If an EPD is not available or cannot be provided, supplier shall provide a letter certifying that an EPD is not available.

D. Shop drawings: Submit each building as a complete unit. Do not mix components from multiple buildings or units of work in a submittal. Include all of the following;

1. Profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
2. Fabrication tolerances for all steel.
3. Connections: All, including type and location of shop and field connections.
4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths, type, size, and sequence. Designate demand critical welds.
5. Cross-reference all shop drawing detail references to contract document detail references.
6. Secure all field measurements as necessary to complete this work prior to submitting shop drawings for review.
7. Provide holes, welded studs, etc. as necessary to secure work of other sections.
8. Provide the following as separate submittals for each building or unit of work:
   a. Bolt and anchor setting plans.
   b. Layout, fabrication and erection drawings.

E. Certifications:

1. Steel Materials: Submit the following for identified materials.
   a. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
   b. Mill Test Reports: Indicate structural strength, destructive test analysis, and non-destructive test analysis.
   c. Contractor's affidavit certifying that all identified steel materials provided are of the grades specified and match the certificates supplied.
2. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification per AWS D1.1.

F. Samples: Provide samples to the Testing Agency as specified in Article SOURCE QUALITY CONTROL, at no additional costs.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies, refer to pertinent sections of Division 01 and CBC Chapter 17A.

B. All tests shall be performed by a recognized testing agency as specified in pertinent sections of Division 01.

C. Certification and Identification of Materials and Uses: Provide Testing Agency with access to fabrication plant to facilitate inspection of steel. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection and all material identification/test information listed below.

1. Test all steel as required by ASTM A6.
2. Provide manufacturer's Mill Test Reports for all materials. Include chemical and physical properties of the material for each heat number manufactured. Tag all fabricated materials with heat number.

3. Provide letter certifying all materials supplied are from heat numbers covered by supplied mill certificates. Include in letter the physical location of each material type and/or heat number in the project (i.e. walls, braced frames etc.).
4. Unidentified Material Tests: Where identification of materials by heat number or mill tests cannot be made, Owner's Testing Agency shall test unidentified materials.
5. Provide all certification, verifications, and other test data required to substantiate specified material properties at no additional cost to the Owner.

D. Testing and Inspection: Tests and Inspections performed by Independent Testing Agency are specified below in Articles SOURCE QUALITY CONTROL and FIELD QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs and test reports in conformance with pertinent sections of Division 01.

E. The following standards are the minimum level of quality required. Provide higher quality work as specifically indicated in the Contract Documents.

1. Workmanship and details of structural steel work shall conform to the CBC and AISC 360.
2. The quality of materials and the fabrication of all welded connections shall conform to AWS D1.1.
3. Comply with Section 10 of AISC 303 for architecturally exposed structural steel.

F. The Testing Agency will review all submittals and testing of materials.

G. All re-inspections made necessary by non-conforming work shall be at the Contractor's expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in bundles marked with durable tags indicating heat number, mill, member size and length, proposed location in the structure and other information corresponding with markings shown on placement diagrams.

B. Handle and store materials above ground to prevent damage, contamination or accumulation of dirt or rust.

1.6 SCHEDULING AND SEQUENCING

A. Organize the work and employ shop and field crew(s) of sufficient size to minimize inspections by the Testing Agency.

B. Provide schedule and sequence information to Testing Agency in writing upon request. Update information as work progresses.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel W Shapes: ASTM A992 Gr. 50 or ASTM A572 Gr. 50.

B. Structural Steel Plates: ASTM A36 or ASTM A572 Gr. 50 or ASTM A529 Gr. 50

C. Structural Steel Channels: ASTM A36 or ASTM A992 Gr. 50.

D. Structural Steel Angles: ASTM A36 or ASTM A572 Gr. 50.

E. HSS (Hollow Structural Sections):

1. Round: ASTM A500, Gr. C.
2. Rectangular or Square: ASTM A500, Gr. C.

F. Pipe: ASTM A53, Grade B.

G. Bolts, Nuts, and Washers: ASTM A307 Grade A machine bolts with ASTM A563 Grade A nuts and ASTM F844 washers to match. See FINISHES section for galvanization, where required.

H. Anchor Bolts/Rods, Nuts, and Washers: ASTM F1554 Gr. 36 or 55 with ASTM A563 Grade A nuts, and ASTM F436 Type 1 washers. Grade DH nuts where Grade 105 rod is specified. No upset thread allowed.

I. Arc-Welding Electrodes: AWS Standards E70 or equivalent, except no E70T-4 allowed.

J. Other Welding Materials: AWS D1.1; type required for materials being welded.

K. Welded Headed/Threaded Studs: AWS D1.1 Type B.

L. Deformed Bar Anchors: ASW D1.1 Type C from ASTM A496 material.

2.2 ACCESSORIES

A. High Strength Grout: ASTM C1107, non-shrink, premixed compound consisting of aggregate, cement, and water reducing plasticizing agents. Minimum compressive strength f'c = 7000 psi at 28 days, placed in a "fluid" state. Non-metallic where exposed to view. BASF "MasterFlow 928" or equivalent.

B. Building Structural Steel Primers: Comply with local VOC limitations of authorities having jurisdiction and the California Green Building Code. Verify compatibility with finish coats specified in other sections. Follow manufacturers printed instructions. Apply one coat unless otherwise directed.

1. Type A: Self-Crosslinking Hydrophobic Acrylic passing 2000 hours ASTM D4585 and 7000 hours ASTM D5894. "Series 115 Uni-Bond DF" by Tnemec (2.0 to 4.0 mils DFT).
2. Type B: Organic Zinc-Rich Urethane passing 50,000 hours ASTM B117 and 15000 hours ASTM G85. "Series 90-97 Tneme-Zinc" by Tnemec (2.5 to 3.5 mils DFT) or "Series 94-H20 Hydro-Zinc" by Tnemec (2.5 to 3.5 mils DFT).
3. Type C: MIO-Zinc Filled Urethane passing 10,000 hours ASTM B117 and 5000 hours ASTM D4585. "Series 394 PerimePrime" by Tnemec (2.5 to 3.5 mils DFT).

C. Galvanizing: ASTM A153 and A123.

D. Touch-Up Primer for Galvanized Surfaces: Type B primer.

2.3 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal built up members by continuous welds where exposed to weather.

C. Fabricate connections for bolt, nut, and washer connectors.

D. Protect all materials, before and after fabrication, from rust, corrosion, dirt, grease, and other foreign matter.

E. Fabricate framing members free from twists or bends. Form holes, cut and sheared edges neatly without kinks, burrs, or warped edges.

F. Exposed Steel: Straight, smooth, free of nicks, scars or dents.

G. Thermal Cutting: Shop performed, mechanically guided thermal cutting of holes in members is permitted. The surface roughness profile of the hole shall not exceed 1,000 microinches as defined in ASME B46.1. Free hand thermally cut holes are not permitted.

H. Splicing of members: Members requiring splicing due to length requirements may be spliced using full penetration butt welds when such welds and procedures are inspected and certified by the Testing Agency, in conformance with AWS and AISC standards. The location of splices shall be approved by the Architect/Engineer in writing prior to fabrication.

I. Welding: Welding of structural steel connections shall be performed by qualified welders in accordance with AWS Standards. All weld sizes shall match those shown on the drawings.

1. Preparation: Clean all surfaces free of rust, paint and all foreign matter. Remove paint or scale by brushing, chipping or hammering as required. Chip clean and wire brush burned or flame cut edges before welding. Space and alternate welds, clamping as necessary to prevent warp or misalignment.
2. Sequence Welding: When welds enclose, or partially enclose, the perimeter or portion of the surface of a member, make weld bead in sequence, or staggered. Minimize internal stresses. Weld groups of members occurring in a single line in staggered sequence to minimize distortion of the structural frame.
3. Faulty and Defective Welding: Welds failing to meet AWS standards and the Contract Documents shall be rejected and remade at Contractor expense. All welds showing cracks, slag inclusion, lack of fusion, bad undercut or other defects, ascertained by visual or other means of inspection shall be removed and replaced with conforming work.
4. Minimum Weld Strengths: All welds shall match the minimum weld sizes recommended by AISC. Details of fabrication not specifically shown shall match similar details which are specifically shown. All bevel and groove welds shall be full penetration unless size is noted otherwise.
5. Threaded studs, headed studs, and deformed bar anchors shall be full-fusion welded conforming to ASW D1.1.

J. Camber: Fabricate all beams cambered as indicated on the drawings.

1. Fabricate beams without camber for installation with any "natural" crown up.
2. Exception: Fabricate cantilever beams with "crown" down.

K. Grinding: Grind smooth the following structural steel and connections;

1. Exposed cut ends of structural and fabricated shapes.
2. All welds exposed to view.
3. Mitered and fit-up corners and intersections.

L. Back-Up Bars: Required for all complete penetration welds.

M. Bolt Holes: Edge, end distances and spacing shall conform to dimensions shown on the drawings, and as follows;

1. Round: Size indicated and 1/16 inch maximum oversize, except 1 inch and larger bolts may have 1/8 inch maximum oversize.
2. Slotted: At locations specifically noted on the drawings, provide size indicated

and 1/16 inch by 1/4 inch oversize slotted in direction perpendicular to applied loads.

3. Holes in base plates for anchor bolts may be 1/8 inch oversize.

N. Comply with Section 10 of AISC 303 for architecturally exposed structural steel (AESS). See architectural & structural drawings for locations of AESS.

2.4 FINISHES

A. Steel exposed to inclement atmospheric conditions or weather (such as coastal moisture or seasonal rain) shall be sufficiently primed or otherwise protected against corrosion. If condition of steel is suspect due to weathering/corrosion, Contractor shall bear cost of inspection to determine if excessive corrosion is present and if steel member(s) requires repair or replacement. Contractor shall bear cost of repair or replacement.

B. Prepare and finish structural and miscellaneous steel component surfaces as follows, unless a higher standard-of-care is determined necessary per item A:

1. Unpainted, interior, dry exposure surfaces need not be primed.
2. Finished painted, interior, dry exposure surfaces:
   a. Surface Preparation: SSPC-SP2 Hand-Tool and/or SP3 Power-Tool Cleaning. Apply Primer Type A. Field touchup with same primer.
   b. Where jobsite exposure is expected to exceed 6 months, SSPC-SP6 / NACE No. 3 Commercial Blast-Cleaning is required. Apply Primer Type B or C. Field touchup with same primer.
3. Finish painted surfaces with exterior exposure, interior exposure subject to wet conditions or fumes, or surfaces to receive high performance finish coatings (for example epoxy or urethane coatings.
   a. Surface Preparation: SSPC-SP6 / NACE No. 3 Commercial Blast-Cleaning to create a dense, uniform angular surface profile of 2.0 mils minimum. For severe (immersion) exposure, SSPC-SP10 / NACE No. 2 Near-White Blast-Cleaning is required.
   b. Apply Primer Type B. Field touchup with same primer.
4. Surfaces to be fire proofed need not be primed unless required by the fireproofing manufacturer or if jobsite exposure is expected to be inclement per item A. Where unprimed steel is to receive fireproofing, prepare steel surface as required by fireproofing manufacturer. If fireproofed surfaces are to be primed, provide primer as follows:
   a. Surface Preparation: SSPC-SP3 Power-Tool Cleaning.
   b. Apply Primer Type C. Field touchup with same primer.
5. Exterior exposed (unpainted) surfaces and as otherwise indicated to receive galvanizing:
   a. Galvanize per ASTM A123 Class 55 minimum. Passivation agents are not permitted on galvanized metal that is to be painted. Provide vent holes per ASTM A385 at closed sections (such as HSS). Submit proposed location of vent holes for review by Engineer.
   b. Connection hardware shall be hot-dip galvanized per ASTM A153 or F2329. Mating bolts and nuts shall receive the same zinc-coating process.
   c. Repair all uncoated, damaged, or altered galvanized surfaces per ASTM A780.

C. Do not prime the following surfaces unless otherwise indicated:

1. Connections to be field welded.
2. Steel in contact with concrete.
3. Surfaces to receive welded metal decking.

D. Do not cover up work with finish materials until inspection is complete and work is approved by the Testing Agency.

2.5 SOURCE QUALITY CONTROL

A. An independent Testing Agency will perform source quality control tests and submit reports, as specified in pertinent sections of Division 01.

B. Steel Materials Testing:

1. No testing is required for materials identified in accordance with CBC 2201A.2 (heat number, grade stencil, etc.).
2. Unidentified steel- General: Test all structural shapes. In addition, test to verify Fy and Fu values when engineering requirements exceed Fy = 25 ksi for design.

C. Shop Welding Inspection:

1. Testing Agency shall inspect and certify all structural welds.
2. Welder Qualifications: Welding inspector shall verify that all the welders are properly qualified prior to steel fabrication and state the qualifications of each welder in the welding inspection report.
3. Welding Inspection: Continuous inspection required unless otherwise noted below. Comply with requirements of AWS D1.1.
   a. Welding Inspector shall check all welds, materials, equipment and procedures.
   b. Welding Inspector shall provide reports certifying the welding is as required and has been done in conformity with the plans, specifications and codes.
   c. Welding Inspector shall use radiographic, ultrasonic, magnetic particle, or any other necessary aid to visual inspection to assure adequacy of welds. Ultrasonic Testing (UT) shall be required for all complete joint penetration (CJP) welds of material 5/16 inch thick or greater.
4. Periodic Inspection Acceptable:
   a. Single pass fillet welds not exceeding 5/16 inch.

D. Bolts, Nuts, and Washers: Provide samples to Testing Agency for required testing, at no additional cost.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Framing:

1. Erect all structural steel true and plumb.
2. Verify proper final alignment prior to making final connections.

C. Field Connections:

1. Workmanship of field bolted and welded connections shall conform in all respects to methods and tolerances specified for fabrication.

2. Field weld components indicated on shop drawings. Sequence field welds to minimize built-up stress and distortion of the structural frame. Verify sequence with Engineer. Coordinate field welding schedule with Testing Laboratory.
3. Welded Studs: Install in accordance with manufacturer's instructions and structural welding code AWS D1.1.

D. Templates: Provide bolt setting templates for all anchor bolts. Provide instructions for the setting of anchors and bearing plates, verify these items are set correctly as work progresses.

E. Column base plates: Set level to correct elevations, support temporarily on steel wedges, shims, or leveling nuts where shown, until the supported members are plumbed and base plate is grouted.

1. Grout solid the full bearing area under base plates prior to installation of floor and/or roof decks.
2. Comply with manufacturer's instructions for high strength grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees, or form edges vertical 1in-2in away from base plate edges. Top of grout outside of base plate footprint shall not extend higher than bottom of base plate.

F. Bolting:

1. Inspect mating surfaces to ensure that bolt head and nut will have full bearing and that metal plies will mate flush between bolts.
2. Install bolts in matching holes. Do not distort metal or enlarge holes by drifting during assembly. Remake mismatched components to achieve tolerances indicated.
3. Holes mismatched in excess of 1/8 inch will be rejected.
4. Holes mismatched less than 1/8 inch may be reamed to the next larger size bolt.
5. Do not enlarge holes by flame cutting or air/arc (“plasma“) cutting.
6. Provide flat washer(s) at over-size holes.
7. Provide washer at bolt head and nut where connected part is less than ¼ inch thick.
8. Provide ASTM F436 beveled washers when the slope of the surfaces of parts in contact with the bolt head or nut is greater than 1:20.
9. Do not install bolts with damaged threads.
10. Threads shall commence outside of the shear plane.
11. Machine Bolts (MB): Install and tighten to a snug condition (ST) such that laminated surfaces bear fully on one another, using an impact wrench or “full effort” of an installer using a standard spud wrench.

G. Supports, Shoring and Bracing: Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing. Conform to requirements of all applicable laws and governing safety regulations. Resist imposed loads, including those of stored materials and equipment.

1. Provide all temporary supports, shoring and bracing necessary to achieve work of tolerances indicated.
2. Provide all necessary temporary flooring, planking and scaffolding required for erection of steel, and support of erection machinery.
3. Construction Loading: Do not overload the structure or temporary supports with stored materials, equipment or other loads.
4. Maintain temporary bracing and shoring until work is complete, and longer as required to ensure stability and safety of structure.

H. Do not make final connections until structure is aligned to meet specified tolerances.

3.3 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. The independent Testing Agency will perform field quality control tests, as specified in pertinent sections of Division 01.

B. Field Welding Inspection: Conform to all requirements of section SOURCE QUALITY CONTROL.

1. Inspect mating surfaces.
2. Test all materials prior to use. Use only materials meeting specified requirements.

3.5 ADJUSTING

A. Touch-up damaged finishes with compatible specified primer.

B. Replace defective or damaged work with conforming work. Replace all defective work at Contractor's expense.

C. Straighten materials by means that will not injure the materials.

D. Replace defective or damaged work which cannot be corrected in the field with new work, or return defective items to the shop for repair.

E. Architect/Engineer shall review all proposals for the repair or replacement of damaged, defective, or missing work.

F. Pay expenses incurred by Owner for Architect/Engineer's costs for (re-)design and obtaining approvals of Authorities Having Jurisdiction (AHJ) necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work, as specified in pertinent sections of Division 01.

G. Pay expenses due to re-testing and re-inspection necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work, as specified in pertinent sections of Division 01.

3.6 CLEANING AND PROTECTION

A. Clean all surfaces upon completion of erection; leave free of grime and dirt. Remove unused materials, tools, equipment and debris from the premises and leave surfaces broomed clean.

B. Protect work from damage by subsequent operations.

END OF SECTION 05 11 00

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: All labor, materials, equipment and operations required to complete structural and miscellaneous metals in shapes and configurations indicated; including:

1. Structural steel columns, beams, bracing, base plates, bolts, joist hangers, and stud bolts welded to structural steel.
2. Miscellaneous structural steel and connections; fabricated connectors and hangers installed by related sections.
3. Anchor bolts and steel inserts embedded in concrete or masonry, installed by related sections.
4. Fabricated steel items embedded in concrete or masonry installed by related sections.
5. Supervision of anchor bolt setting, leveling and elevations to ensure required fit of steel work.
6. Shop priming and field touch-up, galvanizing.
7. Bracing, Shoring, Fabrication and Erection.

B. Related Sections:

1. Pertinent sections of Division 01 specifying Quality Control and Testing Agency services.
2. Pertinent Sections of other Divisions specifying concrete reinforcement, formwork, concrete, structural and miscellaneous metal fabrications, steel joists, metal decking, cold-formed metal framing, rough carpentry.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 22A Steel.

B. American Institute of Steel Construction (AISC) 303 “Code of Standard Practice for Steel Buildings and Bridges”.

C. AISC 341 “Seismic Provisions for Structural Steel Buildings”.

D. AISC 358 “Prequalified Connection for Special and Intermediate Steel Moment Frames for Seismic Applications”.

E. AISC 360 “Specification for Structural Steel Buildings”.

F. American Welding Society (AWS) D1.1 “Structural Welding Code - Steel”.

G. AWS D1.8 “Structural Welding Code - Seismic Supplement”.

H. Research Council on Structural Connections (RCSC) “Specification for Structural Joints Using High-Strength Bolts”.

I. Underwriters Laboratories (UL) FRD “Fire Resistance Directory”.

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer. Submittals that do not meet these requirements will be returned for correction without review.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents.

C. Product Data: Submit manufacturer's product data, specifications, location and installation instructions for proprietary materials and reinforcement accessories. Provide samples of these items upon request.

1. Provide an Environmental Product Declaration (EPD). If an EPD is not available or cannot be provided, supplier shall provide a letter certifying that an EPD is not available.

D. Shop drawings: Submit each building as a complete unit. Do not mix components from multiple buildings or units of work in a submittal. Include all of the following;

1. Profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
2. Fabrication tolerances for all steel.
3. Connections: All, including type and location of shop and field connections.
4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths, type, size, and sequence. Designate demand critical welds.
5. Designation of Seismic Force Resisting System (SFRS) members and connections. Locate and dimension protected zones. Braced frame gusset plates shall be drawn to scale.
6. Cross-reference all shop drawing detail references to contract document detail references.
7. Secure all field measurements as necessary to complete this work prior to submitting shop drawings for review.
8. Provide holes, welded studs, etc. as necessary to secure work of other sections.
9. Provide the following as separate submittals for each building or unit of work:
   a. Bolt and anchor setting plans.
   b. Layout, fabrication and erection drawings.

E. Certifications:

1. Steel Materials: Submit the following for identified materials.
   a. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
   b. Mill Test Reports: Indicate structural strength, destructive test analysis, and non-destructive test analysis.
   c. Contractor's affidavit certifying that all identified steel materials provided are of the grades specified and match the certificates supplied.
2. High-Strength Bolting: Certify all materials provided are the grades specified.
3. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification per AWS D1.1.

F. Samples: Provide samples to the Testing Agency as specified in Article SOURCE QUALITY CONTROL, at no additional costs.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies, refer to pertinent sections of Division 01 and CBC Chapter 17A.

B. All tests shall be performed by a recognized testing agency as specified in pertinent sections of Division 01.

C. Certification and Identification of Materials and Uses: Provide Testing Agency with access to fabrication plant to facilitate inspection of steel. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection and all material identification/test information listed below.

1. Test all steel as required by ASTM A6.
2. Provide manufacturer's Mill Test Reports for all materials. Include chemical and physical properties of the material for each heat number manufactured. Tag all fabricated materials with heat number.
3. Provide letter certifying all materials supplied are from heat numbers covered by supplied mill certificates. Include in letter the physical location of each material type and/or heat number in the project (i.e. walls, braced frames etc.).
4. Unidentified Material Tests: Where identification of materials by heat number or mill tests cannot be made, Owner's Testing Agency shall test unidentified materials.
5. Provide all certification, verifications, and other test data required to substantiate specified material properties at no additional cost to the Owner.

D. Testing and Inspection: Tests and Inspections performed by Independent Testing Agency are specified below in Articles SOURCE QUALITY CONTROL and FIELD QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs and test reports in conformance with pertinent sections of Division 01.

E. The following standards are the minimum level of quality required. Provide higher quality work as specifically indicated in the Contract Documents.

1. Workmanship and details of structural steel work shall conform to the CBC and AISC 360.
2. The quality of materials and the fabrication of all welded connections shall conform to AWS D1.1 and D1.8.
3. Comply with Section 10 of AISC 303 for architecturally exposed structural steel.

F. The Testing Agency will review all submittals and testing of materials.

G. All re-inspections made necessary by non-conforming work shall be at the Contractor's expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in bundles marked with durable tags indicating heat number, mill, member size and length, proposed location in the structure and other information corresponding with markings shown on placement diagrams.

B. Handle and store materials above ground to prevent damage, contamination or accumulation of dirt or rust.

1.6 SCHEDULING AND SEQUENCING

A. Organize the work and employ shop and field crew(s) of sufficient size to minimize inspections by the Testing Agency.

B. Provide schedule and sequence information to Testing Agency in writing upon request. Update information as work progresses.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel W Shapes: ASTM A992 Gr. 50 or ASTM A572 Gr. 50.

B. Structural Steel Plates: ASTM A36 or ASTM A572 Gr. 50 or ASTM A529 Gr. 50

C. Structural Steel Channels: ASTM A36 or ASTM A992 Gr. 50.

D. Structural Steel Angles: ASTM A36 or ASTM A572 Gr. 50.

E. HSS (Hollow Structural Sections):

1. Round: ASTM A500, Gr. C.
2. Rectangular or Square: ASTM A500, Gr. C.

F. Pipe: ASTM A53, Grade B.

G. Bolts and Washers: See FINISHES section for galvanization, where required.

1. Machine Bolts, Nuts, and Washers: Bearing and shear connections (denoted as “MB”); ASTM A307 Grade A machine bolts with ASTM A563 Grade A nuts and ASTM F844 washers to match.
2. High Strength Bolts, Nuts, and Washers: Bearing and shear connections (denoted as “HSB”); ASTM F3125 Grade A325 with ASTM A563 Grade C nuts and ASTM F436 Type 1 washers. Where noted on the drawings provide ASTM A490 bolts with ASTM A563 Grade DH nuts and ASTM F436 Type 1 washers.
   a. HSB-N: For use in snug tight (ST), pretensioned (PT), and slip critical (SC) joints. Conform to the RCSC Specifications.
   b. HSB-X: For use where specified on the drawings.
   c. At Grade A325 bolts use of Grade F1852 (twist off assemblies) is permitted conforming to requirements of RCSC Specifications. At Grade A490 bolts, Grade F2280 is permitted.
   d. Use of ASTM F959 Load Indicator Washers is permitted conforming to the requirements of RCSC Specifications.
   e. Slip critical (SC) bolt faying surfaces shall be prepared per RCSC as Class A, unless noted to be Class B per the drawings. Galvanized surfaces at SC bolts shall be hand wire brushed.

H. Headed Stud Type Shear Connectors: AWS D1.1 Type B.

I. Deformed Bar Anchors: ASW D1.1 Type C from ASTM A496 material.

J. Anchor Bolts/Rods:

1. ASTM F1554 Grade 36 or 55 with ASTM A563 Grade A nuts and ASTM F436 Type 1 washers.
2. ASTM F1554 Grade 105 where indicated on plans with ASTM A563 Grade DH nuts and ASTM F436 Type 1 washers.
3. No upset thread allowed.

K. Arc-Welding Electrodes: AWS Standards E70 or equivalent, except no E70T-4 allowed.

Additionally, welding electrodes to be used in the welding of seismic force resisting system to conform to AISC 341 and AWS D1.8.

L. Other Welding Materials: AWS D1.1; type required for materials being welded.

2.2 ACCESSORIES

A. High Strength Grout: ASTM C1107, non-shrink, premixed compound consisting of aggregate, cement, and water reducing plasticizing agents.

1. Minimum Compressive Strength at 3 days: 3000 psi, placed in a “fluid” state.
2. Minimum Compressive Strength at 28 days: 7000 psi, placed in a “fluid” state.
3. Provide only non-metallic grout at exposed work.
4. Meet or exceed properties of BASF "Master Flow 928" mixed to fluid consistency. Other acceptable manufacturers: The Burke Company and W.R. Meadows, Inc.

B. Building Structural Steel Primers: Comply with local VOC limitations of authorities having jurisdiction and the California Green Building Code. Verify compatibility with finish coats specified in other sections. Follow manufacturers printed instructions. Apply one coat unless otherwise directed.

1. Type A: Self-Crosslinking Hydrophobic Acrylic passing 2000 hours ASTM D4585 and 7000 hours ASTM D5894. “Series 115 Uni-Bond DF” by Tnemec (2.0 to 4.0 mils DFT).
2. Type B: Organic Zinc-Rich Urethane passing 50,000 hours ASTM B117 and 15000 hours ASTM G85. “Series 90-97 Tneme-Zinc” by Tnemec (2.5 to 3.5 mils DFT) or “Series 94-H20 Hydro-Zinc” by Tnemec (2.5 to 3.5 mils DFT).
3. Type C: MIO-Zinc Filled Urethane passing 10,000 hours ASTM B117 and 5000 hours ASTM D4585. “Series 394 PerimePrime” by Tnemec (2.5 to 3.5 mils DFT).

C. Galvanizing: ASTM A153 and A123.

D. Touch-Up Primer for Galvanized Surfaces: Type B primer.

2.3 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal built up members by continuous welds where exposed to weather.

C. Fabricate connections for bolt, nut, and washer connectors.

D. Protect all materials, before and after fabrication, from rust, corrosion, dirt, grease, and other foreign matter.

E. Fabricate framing members free from twists or bends. Form holes, cut and sheared edges neatly without kinks, burrs, or warped edges.

F. Exposed Steel: Straight, smooth, free of nicks, scars or dents.

G. Thermal Cutting: Shop performed, mechanically guided thermal cutting of holes in members is permitted. The surface roughness profile of the hole shall not exceed 1,000 microinches as defined in ASME B46.1. Free hand thermally cut holes are not permitted.

H. Splicing of members: Members requiring splicing due to length requirements may be spliced using full penetration butt welds when such welds and procedures are inspected

and certified by the Testing Agency, in conformance with AWS and AISC standards. The location of splices shall be approved by the Architect/Engineer in writing prior to fabrication.

I. Welding: Welding of structural steel connections shall be performed by qualified welders in accordance with AWS Standards. All weld sizes shall match those shown on the drawings.

1. Preparation: Clean all surfaces free of rust, paint and all foreign matter. Remove paint or scale by brushing, chipping or hammering as required. Chip clean and wire brush burned or flame cut edges before welding. Space and alternate welds, clamping as necessary to prevent warp or misalignment.
2. Sequence Welding: When welds enclose, or partially enclose, the perimeter or portion of the surface of a member, make weld bead in sequence, or staggered. Minimize internal stresses. Weld groups of members occurring in a single line in staggered sequence to minimize distortion of the structural frame.
3. Faulty and Defective Welding: Welds failing to meet AWS standards and the Contract Documents shall be rejected and remade at Contractor expense. All welds showing cracks, slag inclusion, lack of fusion, bad undercut or other defects, ascertained by visual or other means of inspection shall be removed and replaced with conforming work.
4. Minimum Weld Strengths: All welds shall match the minimum weld sizes recommended by AISC. Details of fabrication not specifically shown shall match similar details which are specifically shown. All bevel and groove welds shall be full penetration unless size is noted otherwise.
5. Threaded studs, headed studs, and deformed bar anchors shall be full-fusion welded conforming to ASW D1.1.

J. Camber: Fabricate all beams cambered as indicated on the drawings.

1. Fabricate beams without camber for installation with any "natural" crown up.
2. Exception: Fabricate cantilever beams with "crown" down.

K. Grinding: Grind smooth the following structural steel and connections;

1. Exposed cut ends of structural and fabricated shapes.
2. All welds exposed to view.
3. Mitered and fit-up corners and intersections.

L. Back-Up Bars: Required for all complete penetration welds. See requirements of AISC 358.

M. Bolt Holes: Edge, end distances and spacing shall conform to dimensions shown on the drawings, and as follows;

1. Round: Size indicated and 1/16 inch maximum oversize, except 1 inch and larger bolts may have 1/8 inch maximum oversize.
2. Slotted: At locations specifically noted on the drawings, provide size indicated and 1/16 inch by 1/4 inch oversize slotted in direction perpendicular to applied loads.
3. Holes in base plates for anchor bolts may be 1/8 inch oversize.

N. Comply with Section 10 of AISC 303 for architecturally exposed structural steel (AESS). See architectural & structural drawings for locations of AESS.

2.4 FINISHES

A. Steel exposed to inclement atmospheric conditions or weather (such as coastal moisture or seasonal rain) shall be sufficiently primed or otherwise protected against corrosion. If condition of steel is suspect due to weathering/corrosion, Contractor shall bear cost of inspection to determine if excessive corrosion is present and if steel member(s) requires repair or replacement. Contractor shall bear cost of repair or replacement.

B. Prepare and finish structural and miscellaneous steel component surfaces as follows, unless a higher standard-of-care is determined necessary per item A:

1. Unpainted, interior, dry exposure surfaces need not be primed.
2. Finished painted, interior, dry exposure surfaces:
   a. Surface Preparation: SSPC-SP2 Hand-Tool and/or SP3 Power-Tool Cleaning. Apply Primer Type A. Field touchup with same primer.
   b. Where jobsite exposure is expected to exceed 6 months, SSPC-SP6 / NACE No. 3 Commercial Blast-Cleaning is required. Apply Primer Type B or C. Field touchup with same primer.
3. Finish painted surfaces with exterior exposure, interior exposure subject to wet conditions or fumes, or surfaces to receive high performance finish coatings (for example epoxy or urethane coatings.
   a. Surface Preparation: SSPC-SP6 / NACE No. 3 Commercial Blast-Cleaning to create a dense, uniform angular surface profile of 2.0 mils minimum. For severe (immersion) exposure, SSPC-SP10 / NACE No. 2 Near-White Blast-Cleaning is required.
   b. Apply Primer Type B. Field touchup with same primer.
4. Surfaces to be fire proofed need not be primed unless required by the fireproofing manufacturer or if jobsite exposure is expected to be inclement per item A. Where unprimed steel is to receive fireproofing, prepare steel surface as required by fireproofing manufacturer. If fireproofed surfaces are to be primed, provide primer as follows:
   a. Surface Preparation: SSPC-SP3 Power-Tool Cleaning.
   b. Apply Primer Type C. Field touchup with same primer.
5. Exterior exposed (unpainted) surfaces and as otherwise indicated to receive galvanizing:
   a. Galvanize per ASTM A123 Class 55 minimum. Passivation agents are not permitted on galvanized metal that is to be painted. Provide vent holes per ASTM A385 at closed sections (such as HSS). Submit proposed location of vent holes for review by Engineer.
   b. Connection hardware shall be hot-dip galvanized per ASTM A153 or F2329. Grade A325 high-strength bolt assemblies may be mechanically galvanized per ASTM B695 class 55 or hot-dip galvanized per ASTM F2329. Mating bolts and nuts shall receive the same zinc-coating process.
   c. Repair all uncoated, damaged, or altered galvanized surfaces per ASTM A780.

C. Do not prime the following surfaces unless otherwise indicated:

1. Connections to be field welded.
2. Steel in contact with concrete.
3. Surfaces to receive welded metal decking.

D. Slip critical bolted connection surfaces shall either be unfinished & prepared per the RCSC or primed per item B3 or B4.

E. Do not cover up work with finish materials until inspection is complete and work is approved by the Testing Agency.

2.5 SOURCE QUALITY CONTROL

A. An independent Testing Agency will perform source quality control tests and submit reports, as specified in pertinent sections of Division 01.

B. Steel Materials Testing:

1. No testing is required for materials identified in accordance with CBC Section 2201A.2 (heat number, grade stencil, etc.).
2. Unidentified steel- General: Test all structural shapes. In addition, test to verify Fy and Fu values when engineering requirements exceed Fy = 25 ksi for design.
3. Charpy V-Notch (CVN) testing requirements are per AISC 341. Heavy sections requiring CVN testing are indicated on the documents.

C. Shop Welding Inspection:

1. Testing Agency shall inspect and certify all structural welds.
2. Welder Qualifications: Welding inspector shall verify that all the welders are properly qualified prior to steel fabrication and state the qualifications of each welder in the welding inspection report.
3. Welding Inspection: Continuous inspection required unless otherwise noted below. Comply with requirements of AWS D1.1, AWS D1.8 and AISC 341.
   a. Welding Inspector shall check all welds, materials, equipment and procedures.
   b. Welding Inspector shall provide reports certifying the welding is as required and has been done in conformity with the plans, specifications and codes.
   c. Welding Inspector shall use radiographic, ultrasonic, magnetic particle, or any other necessary aid to visual inspection to assure adequacy of welds. Ultrasonic Testing (UT) shall be required for all complete joint penetration (CJP) welds of material 5/16 inch thick or greater.
4. Periodic Inspection Acceptable:
   a. Single pass fillet welds not exceeding 5/16 inch.
   b. Welding of studs to beams.

D. Bolts, Nuts and Washers: Provide samples to Testing Agency for required testing, at no additional cost.

E. High Strength Bolted Connections: Provide testing and verification of shop-bolted connections in accordance with RCSC specifications. Test all bolts at each connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Framing:

1. Erect all structural steel true and plumb.
2. Verify proper final alignment prior to making final connections.

C. Field Connections:

1. Workmanship of field bolted and welded connections shall conform in all respects to methods and tolerances specified for fabrication.
2. Field weld components indicated on shop drawings. Sequence field welds to minimize built-up stress and distortion of the structural frame. Verify sequence with Engineer. Coordinate field welding schedule with Testing Laboratory.
3. Welded Studs: Install in accordance with manufacturer's instructions and structural welding code AWS D1.1 and AWS D1.8.

D. Templates: Provide bolt setting templates for all anchor bolts. Provide instructions for the setting of anchors and bearing plates, verify these items are set correctly as work progresses.

E. Column base plates: Set level to correct elevations, support temporarily on steel wedges, shims, or leveling nuts where shown, until the supported members are plumbed and base plate is grouted.

1. Grout solid the full bearing area under base plates prior to installation of floor and/or roof decks.
2. Comply with manufacturer's instructions for high strength grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees, or form edges vertical 1in-2in away from base plate edges. Top of grout outside of base plate footprint shall not extend higher than bottom of base plate.

F. Bolting - General:

1. Inspect mating surfaces to ensure that bolt head and nut will have full bearing and that metal plies will mate flush between bolts.
2. Install bolts in matching holes. Do not distort metal or enlarge holes by drifting during assembly. Remake mismatched components to achieve tolerances indicated.
3. Holes mismatched in excess of 1/8 inch will be rejected.
4. Holes mismatched less than 1/8 inch may be reamed to the next larger size bolt.
5. Do not enlarge holes by flame cutting or air/arc (“plasma“) cutting.
6. Provide flat washer(s) at over-size holes.
7. Provide washers for all conditions per RCSC Section 6 and under nuts to connected parts less than ¼ inch thick.
8. Provide ASTM F436 beveled washers when the slope of the surfaces of parts in contact with the bolt head or nut is greater than 1:20.
9. Do not install bolts with damaged threads.
10. Threads shall commence outside of the shear plane where noted as HSB-X on drawings..

G. Bolting - Specific:

1. Machine Bolts (MB): Install and tighten to a snug condition (ST) such that laminated surfaces bear fully on one another, using an impact wrench or “full effort” of an installer using a standard spud wrench.
2. High Strength Bolts in Bearing/Shear or Static Tension joints snug tight (ST):
   a. Provide a hardened washer at the head/nut at slotted holes
   b. Install and tighten as per Machine Bolts (MB) snug tight (ST) and other requirements of RCSC specification Section 8.
   c. Use ASTM F436 washer only in snug tight connections with static tension loads.
3. High Strength Bolts in Pretensioned joints (PT):
   a. Provide ASTM F436 washer per requirements of RCSC Section 6.

b. Install and tighten in accordance with the requirements of RCSC Section 8.
c. Install bolts in all holes of the joint and compact the joint until the connected plies are in firm contact prior to pretensioning.
d. The following tightening methods and bolt type are acceptable for PT joints:
(a) Turn-of-the-nut pretensioning method
(b) Calibrated wrench pretensioning method
(c) Twist-off-type tension-control bolts
(d) Direct-tension-indicator washer pretensioning method.

4. High Strength Bolts in Slip Critical (SC) joints:
a. Provide tensioning for High Strength Bolts (PT) per above.
b. Faying surfaces to be prepared per RCSC Section 3 and PART 2.

H. Supports, Shoring and Bracing: Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing. Conform to requirements of all applicable laws and governing safety regulations. Resist imposed loads, including those of stored materials and equipment.

1. Provide all temporary supports, shoring and bracing necessary to achieve work of tolerances indicated.
2. Provide all necessary temporary flooring, planking and scaffolding required for erection of steel, and support of erection machinery.
3. Construction Loading: Do not overload the structure or temporary supports with stored materials, equipment or other loads.
4. Maintain temporary bracing and shoring until work is complete, and longer as required to ensure stability and safety of structure.

I. Do not make final connections until structure is aligned to meet specified tolerances.

3.3 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. The independent Testing Agency will perform field quality control tests, as specified in pertinent sections of Division 01.

B. Field Welding Inspection: Conform to all requirements of section SOURCE QUALITY CONTROL.

C. High Strength Bolting: Provide testing and verification of field-bolted connections in accordance with RCSC Section 9.

1. Inspect mating surfaces.
2. Test all materials prior to use. Use only materials meeting specified requirements.
3. Inspector shall review installation and verify “full effort” with installers for ST joints and shall randomly manually verify “full effort” on 10 percent of installed bolts.
4. Inspector shall verify installation for 100% of SC and PT joints.
5. Review installation procedures for all types of HSB joints and verify installation of “Twist-off” and load-indicator type bolts.
6. If any bolt fails testing, all bolts at the joint shall be loosened and re-tightened.

Exception: Galvanized bolts shall be replaced prior to re-testing.

D. Welded Studs: Test headed studs electro-magnetically welded through metal deck to directly to steel members as follows:

1. Install minimum of two trial studs.
2. Testing Agency shall bend studs with a hammer to minimum 30 degrees out of axis.
3. Any failure shall require new studs be welded for another test and welding apparatus adjusted.

3.5 ADJUSTING

A. Touch-up damaged finishes with compatible specified primer.

B. Replace defective or damaged work with conforming work. Replace all defective work at Contractor's expense.

C. Straighten materials by means that will not injure the materials.

D. Replace defective or damaged work which cannot be corrected in the field with new work, or return defective items to the shop for repair.

E. Architect/Engineer shall review all proposals for the repair or replacement of damaged, defective, or missing work.

F. Pay expenses incurred by Owner for Architect/Engineer's costs for (re-)design and obtaining approvals of Authorities Having Jurisdiction (AHJ) necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work, as specified in pertinent sections of Division 01.

G. Pay expenses due to re-testing and re-inspection necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work, as specified in pertinent sections of Division 01.

3.6 CLEANING AND PROTECTION

A. Clean all surfaces upon completion of erection; leave free of grime and dirt. Remove unused materials, tools, equipment and debris from the premises and leave surfaces broomed clean.

B. Protect work from damage by subsequent operations.

END OF SECTION 05 12 00

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All design and other services, material, labor and equipment as necessary for the fabrication, erection and completion of all cold formed metal framing including all bracing and shoring required for erection, miscellaneous metal, and related work.

B. Related Sections:

1. Pertinent Sections of Division 01 Specifying Quality Control and Testing Agency Sections
2. Pertinent Sections of Division 05 Specifying Structural Steel.

1.2 REFERENCE STANDARDS

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 22A Steel.

B. American Iron and Steel Institute (AISI) S100 “North American Specification for the Design of Cold-Formed Steel Structural Members”.

C. AISI S200 “North American Standard for Cold-Formed Steel Framing – General Provisions”.

D. AISI D100 “Cold-Formed Steel Design Manual.

E. American Welding Society (AWS) D1.3 “Structural Welding Code – Sheet Steel”

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

1. ASTM A307 “Stand Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength”.
2. ASTM A606 “Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance”.
3. ASTM A653 “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”.
4. ASTM A780 “Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings”.
5. ASTM A1003 “Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members”.
6. ASTM A1008 “Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable”.
7. ASTM A1011 “Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength”.
8. ASTM C645 “Standard Specification for Nonstructural Steel Framing Members”.

9. ASTM C754 “Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products”.
10. ASTM C955 “Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases”.
11. ASTM C1007 “Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories”.
12. ASTM C1513 “Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections”.

G. The Society for Protective Coatings (SSPC) SSPC-Paint20 “Zinc-Rich Coating (Inorganic or Organic)”.

H. National Institute of Standards and Technology (NIST) / Engineered Wood Association (APA) “PS 1 - Voluntary Product Standard for Structural Plywood”.

I. NIST / APA “PS 2 - Performance Standard for Wood-Based Structural-Use Panels”.

1.3 SUBMITTALS

A. Manufacturer's Literature:

1. Descriptive data illustrating cold-formed framing system components including framing members, fasteners, and accessories, including ICC-ES reports.
2. Erection instructions containing sequence of operations.

B. Samples: Provide adequate samples of unidentified material to the Owner's Testing Laboratory for testing purposes.

1.4 QUALITY ASSURANCE

A. Erector Qualifications:

1. Minimum of three years successful experience on comparable cold-formed metal framing projects.
2. Welders qualified in accordance AWS D1.3.

B. Cold form carbon and low alloy steel used for structural purposes shall be identified per CBC Section 2201A.2.

C. Welding inspections shall conform to AWS D1.3 and CBC 1705A.2.

D. Wood product quality standards:

1. All wood products to comply with article REFERENCES.
2. Factory-mark each piece of sheathing with type, grade, mill, and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.
3. Sheathing panels to be marked by APA (The Engineered Wood Association).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent requirements of Division 01.

B. Delivery: Time delivery and installation of carpentry products to avoid delaying other trades whose work is dependent on or affected by this section and to comply with moisture content, protection and storage requirements.

C. Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and sheathing panels to prevent deformation and provide air circulation within stacks.

1. Store materials for which a maximum moisture content is specified only in areas where relative humidity has been reduced to a level where specified moisture content can be maintained.
2. Handle and store materials above ground to prevent damage, contamination, or accumulation of dirt or foreign materials.

D. Provide special protection for horizontal sheathing panels. Deformation of panels due to moisture is not acceptable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Framing System:

1. All stud and/or joist framing members shall be of the type & size as shown on the plans and reviewed shop drawings. Framing member section properties (thickness, dimensions, area, section modulus, and moment of inertia) shall match those per AISI D100 unless noted otherwise on drawings.
2. All runner and end tracks, bridging, and non-load bearing studs shall be of the type & size shown on the plans.
3. All studs, joists, and tracks 54 mils or greater in thickness shall be formed from steel that corresponds to the requirements of ASTM A1003 (Grade ST50H or ST50L) with a minimum yield of 50,000 psi.
4. All studs, joists, track, bridging, U-channel, (hat) furring (F) channels, and accessories 43 mils or thinner in thickness shall be formed from steel that corresponds to the requirements of ASTM A1003 (Grade ST33H or ST33L) with a minimum yield of 33,000 psi.
5. All stud and joist components shall be formed from steel having a minimum G-60 galvanized coating (equivalent coatings such as “G60e” are not acceptable), unless noted otherwise, or shall be primed with paint meeting the performance requirements SSPC-Paint20, where noted.
6. Welding Electrodes: Shall conform to AWS D1.3. E60 or E70. Touch up all welds with zinc-rich paint in compliance with ASTM A780.
7. Primer: SSPC-Paint20.

B. Screws shall be per ASTM C1513.

C. Machine bolts shall be per ASTM A307.

D. Power Actuated Fasteners (PAF): Hilti X-U, ICC ESR-2269. For use only where specified by the drawings.

E. Accessories: Cold-formed metal framing manufacturer's standard.

F. Structural Sheathing Panels:

1. Plywood: Structural sheathing shall conform to product standard PS-1 or PS-2. All panels shall have a minimum bond classification of “Exposure 1” and bear the trademark of the Engineered Wood Association (APA) or other qualified agency. Grades shall be “Rated Sheathing” or “Structural 1” as required on the drawings.

G. Oriented Strand Board (OSB): All structural OSB shall be grade marked by a qualified agency for conformance with Product Standard PS-2 and shall be fabricated with exterior glue. Grades shall be as required on the drawings.

2.2 FABRICATION

A. Form members to manufacturer's standard shapes meeting design criteria.

B. Cut right angle connections of framing components to fit squarely against abutting members.

C. Prime un-galvanized steel to 1.5 mil (0.038) minimum dry film thickness.

PART 3 - EXECUTION

3.1 ERECTION

A. Clean surfaces that will be in contact after assembly.

B. Position members plumb, square and true to line.

C. Seat studs squarely in track with stud web and flange abutting track web with maximum 1/8 inch gap.

D. Connect members together by welding and/or fasteners in accordance with the drawings.

E. Do not splice studs. Provide "headers" and "trim studs" at openings as required. Studs shall be securely attached to tracks at all exterior walls except as noted below.

F. Provide for expansion and contraction between floors at solid wall sections of two stories or more by providing a slip joint between stud and track at one end. This connection shall be capable of transmitting lateral loads to the structure.

G. Provide and install bridging, fire blocking, etc. per manufacturer's recommendations, the plans, and code requirements.

H. Perform welding in accordance with AWS D1.3

I. Remove erection bolts and screws used in welded construction.

J. Do not use gas cutting for field correction of fabrication without concurrence of Architect/Engineer.

K. Touch-up field connections and breaks in shop coating with same primer used for shop priming.

3.2 STRUCTURAL SHEATHING

A. General:

1. Sheathing screwing shall be as required on the drawings. Do not overdrive (Do not break skin of sheathing face sheet). Over driving will be cause for rejection.

B. Roof and Floor Sheathing: lay with face grain perpendicular to roof rafters, roof trusses or floor joists. Stagger sheets. Block all unsupported sheet edges with 54 mils material unless noted otherwise.

C. Wall Sheathing: Lay with face grain either parallel or perpendicular to studs. Exposed bottom edges shall be sealed as recommended by manufacturer. Block all unsupported sheet edges with 54 mils materials unless noted otherwise.

3.3 DEFECTIVE WORK AND MATERIALS

A. Work found to be defective, missing or damaged shall be immediately replaced with proper work. Such replaced work and the inspection for same shall be at the expense of the Contractor.

B. Straightening of any materials, if necessary, shall be done by a process and in a manner that will not injure the materials, and which is approved by the Architect. Sharp kinks or bends shall be cause for rejection. Heating will not be allowed.

C. If defects or damaged work cannot be corrected in the field, the material shall be returned to the shop or new parts furnished, as the Architect directs; the Contractor shall replace all work at his own expense.

3.4 CLEANING

A. After erection, all surfaces shall be cleaned and left free of all grime and dirt. Remove unused materials, tools, equipment and debris from the premises and leave broom clean.

3.5 FIELD QUALITY CONTROL

A. The Testing Agency, as specified in the Article QUALITY ASSURANCE, will perform the following tests and submit reports as specified in Division 01:

1. Periodic special inspection of welding operations of elements of the seismic force-resisting system, screw attachment, bolting, anchoring and other fastening of elements within the seismic-force-resisting system, including shear walls, braces, diaphragms, collectors (drag struts) and holdowns per CBC Section 1705.13.3, excluding cold-formed steel light-frame shear walls and diaphragms, including screw installation, bolting, anchoring and other fastening to components of the seismic force-resisting system, where either of the following applies: 1) the sheathing is gypsum board or fiberboard, or 2) the sheathing is wood structural panel or steel sheets on only one side of the shear wall, shear panel or diaphragm assembly and the specified fastener spacing at the panel or sheet edge is more than 4 inches on center.

END OF SECTION 05 40 00

SECTION 05 52 00 – HANDRAILS AND RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel tubing guide rail.

B. Brackets and fittings.

1.2 REFERENCES

A. CAS/CAR – California Accessibility Statues/California Accessibility Regulations, Books 1 and 2, May 1994.

B. ASTM - American Society for Testing and Materials

C. Uniform Building Code, latest adopted edition, as amended by California Building Code 2001 edition Volume 2, Chapter 22, (noted herein as CBC) and the UBC Standard 22-1.

D. "Standard Code for Welding in Building Construction", American Welding Society (AWS).

E. ASTM A 269 – Pipe and tubing

F. ASTM A 276 – Bar and fittings

G. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

H. Related Work Specified Elsewhere

1. Section 01 4500: Quality Control

1.3 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 01 3300.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners and accessories.

C. Sample: Submit three samples of handrail and each component.

D. Welder Certifications.

1.4 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.1 STEEL RAILING SYSTEM

A. Fasteners, Plates, Brackets, Flanges and Bases: Manufactured by Craneveyor Corp., South El Monte, CA., or equal.

B. Handrails, Guardrails, Posts, Pickets, Rails: size as shown on Drawings. Welded joints, stainless steel, SS316.

1. Pipe yield strength: 35 ksi.

C. Fittings: Elbows, T-shapes, wall brackets, escutcheons: Cast steel. Brackets: Round top to accept tube rail, size to allow minimum 1-1/2 inch clearance from rail to wall.

D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

E. Finish: Clean stainless finish, no paint.

F. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 24 hours and 8,000 psi in 7 days; SUPER POR-ROK ANCHORING CEMENT manufactured by Minwax Construction Products Division, Montvale, NJ, or an approved equal meeting the same standard of performance.

G. Epoxy Adhesive: Two component material suitable for anchoring into dry or damp concrete. Same as Burke's "Burk Epoxy MV", Covert's "CIA-Gel 7000", Hilti's "HIT C-100" or equal product.

2.2 FABRICATION

A. Fabricate guiderails of specified tubing only in conformance with CSAS requirements.

B. Fit and stop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

G. Accurately form components to each other and to build structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means the erector accepts existing conditions.

3.2 PREPARATION

A. Clean and strip steel items to bare metal where site welding is required.

3.3 INSTALLATION

A. Set vertical supports in core-drilled holes with the specified non-shrink grout or epoxy adhesive.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. Provide anchors, plates or angles required for connecting railings to structure. Anchor railing to structure.

D. Field weld anchors as indicated on shop drawings. Grind welds smooth.

E. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

F. Touch up welds and chipped surfaces with specified galvanizing compound prior to completion.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Plumb: ¼ Inch in 10 feet.

3.5 DEFECTIVE WORK AND MATERIALS

A. Work found to be defective, missing or damaged shall be immediately replaced with proper work. Such replaced work and the inspection for same shall be at the expense of the Contractor. All proposals for the repair or replacement of damaged, defective, or missing work to be reviewed by the Architect.

B. Straightening of any materials, if necessary, shall be done by a process and in a manner that will not injure the materials.

C. If defects or damage work cannot be corrected in the field, the material shall be returned to the shop or new parts furnished. The Contractor shall replace all work at his own expense.

3.6 CLEANING

A. After erection, all surfaces shall be cleaned and left free of all grime and dirt. Remove unused materials, tools, equipment and debris from the premises and leave broom clean.

B. Surfaces: Clean welds, bolted connections and abraded areas and apply galvanizing repair. Knock down welds, clean, and polish as required for smooth surface.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: All labor, materials and equipment, and all operations required to complete all rough carpentry and structural framing as indicated on the drawings; to produce shapes and configurations as shown, as required; and as specified herein, including:

1. Structural floor, wall, and roof framing.
2. Floor, wall, and roof sheathing.
3. Rough hardware, framing connectors, and fasteners.
4. Treatment of wood.
5. Concealed wood blocking for support of toilet and bath accessories, wall cabinets, wood trim, and other work requiring supporting blocking.
6. Miscellaneous wood nailers and furring strips, including roof applications, other wood framing, furring, shims, or blocking as required to complete the work.

B. Related Sections:

1. Pertinent sections of Division 01 specifying Quality Control and Testing Agency services.
2. Pertinent sections of Division 01 specifying Structural Product Requirements: Structural Product Options, Substitution procedures and limitations, transportation, handling and storage.
3. Pertinent sections of Division 03 specifying wood formwork construction and/or setting anchors in concrete.
4. Pertinent section of Division 06 specifying wood construction and materials.
5. Pertinent sections of other divisions specifying steel or concrete construction.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 23 Wood.

B. American National Standards Institute (ANSI) / American Wood Council (AWC) “NDS - National Design Specification for Wood Construction”.

C. National Institute of Standards and Technology (NIST) / Engineered Wood Association (APA) “PS 1 - Voluntary Product Standard for Structural Plywood”.

D. NIST / APA “PS 2 - Performance Standard for Wood-Based Structural-Use Panels”.

E. NIST “PS 20 - American Softwood Lumber Standard”.

F. Redwood Inspection Bureau (RIS) “Standard Specifications for Grades of California Redwood Lumber”.

G. West Coast Lumber Inspection Bureau (WCLIB) “Standard Grading Rules for West Coast Lumber No. 17”.

H. Western Wood Products Association (WWPA) “Western Lumber Grading Rules”.

I. American Wood Preservers Association (AWPA) “Book of Standards”.

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. Submit for review prior to fabrication. Submittals that do not meet these requirements will be returned for correction without review.

1. Substitutions for products specified require conformance to substitution requirements in Division 01.
2. Review of materials and hardware for substitution to products specified is at the additional expense of the Contractor.

B. Limitation of Review: Structural Engineer's review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer.

C. Product Data:

1. Submit manufacturer's product data, specifications, and installation instructions for & location of framing connectors, wood preservative materials, application instructions, and fasteners. Include complete, accurate equivalence data when submitting alternate products to those specified. Provide samples of these items upon request.
2. Submit product data and current ICC-ES report for machine-driven nails, fasteners, and equipment, including dimensions of all fasteners, including head, shank diameter and length.

D. Shop drawings: For manufactured wood products, submit each building as a complete unit. Do not mix components from multiple buildings or units of work in a submittal. Include all of the following:

1. Indicate profiles, sizes, and spacing locations of structural members.
2. Cross-reference all shop drawing detail references to contract document detail references.
3. Secure all field measurements as necessary to complete this work.

E. Manufacturer's Certificate: Submit all certifications of physical and chemical properties of materials as specified below in Article titled QUALITY ASSURANCE.

1. Certify that wood products supplied for rough carpentry meet or exceed specified requirements, including specified moisture content.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies, refer to pertinent sections of Division 01 and CBC Chapter 17A.

B. All tests shall be performed by a recognized testing agency as specified in pertinent sections of Division 01.

C. Inspection of fabricators is required per CBC 1704A.2.5 unless fabricator is registered and approved by the building official. Wood product quality standards:

1. All wood products shall comply with article REFERENCES.
2. Factory-mark each piece of lumber and sheathing with type, grade, mill, and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.
3. Sheathing panels to be marked by APA (The Engineered Wood Association).

D. End-Jointed lumber shall not be used.

E. Hardware and engineered wood products shall have current ICC ES Evaluation/research reports that are equivalent to products specified.

F. Employ competent workers who are experienced in work of the types specified and required.

1.5 MOCK-UP

A. Construct mock-ups of machine-driven nailed sheathing panels using submitted products and demonstrating conditions indicated. Locate where directed.

B. Mock-up shall be accepted and approved by the Inspector of Record (IOR) before commencement of machine-driven nailing activity.

C. Accepted mock-up shall remain exposed for reference for the duration of machine-driven nailing activity.

D. Remove all mock-ups at the completion of the work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with pertinent requirements of Division 01.

B. Delivery: Time delivery and installation of carpentry products to avoid delaying other trades whose work is dependent on or affected by this section and to comply with moisture content, protection and storage requirements.

C. Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and sheathing panels to prevent deformation and provide air circulation within stacks.

1. Store materials for which a maximum moisture content is specified only in areas where relative humidity has been reduced to a level where specified moisture content can be maintained.
2. Handle and store materials above ground to prevent damage, contamination, or accumulation of dirt or foreign materials.
3. Provide special protection for horizontal sheathing panels. Deformation of panels due to moisture is not acceptable.

1.7 PROJECT/SITE CONDITIONS

A. Verify all conditions at project site affecting the work; work to field dimensions as required. Coordinate carpentry installation with size, location, and installation of service utilities.

B. Sequence rough carpentry installation activities to allow sufficient time for:

1. Review of all submittals.
2. Fabrication of mock-ups and required durations as specified.
3. Indicate submittal review, procurement, mock-up, and testing activities in the project schedule prior to the start of installation. Installation durations shall be based on hand-nailed installation methods specified.
4. Attainment of specified maximum lumber moisture content.

PART 2 - PRODUCTS

2.1 DIMENSIONED LUMBER

A. General

1. Size per industry standards for nominal sizes shown; S4S (surfaced four sides).
2. Warped/twisted and excessively checked members shall not be used regardless of grade marks.
3. At the Contractor's option, engineered lumber of equivalent size and material properties may be substituted for solid sawn lumber where material is difficult to source due to length, availability, etc. Submit proposed substitution to Engineer for review prior to purchasing materials.

B. Moisture content of framing:

1. All sawn lumber to be maximum 19% at time of fastener installation and at time of close-in, unless noted otherwise.
2. The Owner's Testing Laboratory will test for moisture content prior to commencement of close-in.
3. The Contractor shall recognize that excessive shrinkage of lumber results from excess moisture content at the time of installation. The Contractor will compensate for use of such lumber by waiting for acceptable moisture content before close-in and/or by replacing/repairing lumber that has sagged, twisted, or warped prior to close-in.
4. Deviation from this specification would require structural redesign of connections and fasteners.

C. Interior structural framing shall be Douglas Fir (D.F.) with grades as noted below, unless otherwise specified on the drawings. All grades are per WCLIB standard grading rules.

1. All permanently exposed (interior or protected from weather) framing shall be select structural grade with no box heart.
2. Except per 1 above, unless noted otherwise, minimum grades are:
   a. Floor/roof joists/rafters (2x) and 2x8 & larger studs: D.F. No. 1
   b. 2x4 and 2x6 studs and plates: D.F. No. 1
   c. 4x and larger: D.F. No. 1
   d. Blocking: D.F. No. 2
   e. 6x8 and larger posts and beams may be SGL/CGL per below unless noted otherwise on the drawings.

D. Sills and ledgers in contact with concrete or masonry: D.F. No. 2 pressure treated and as called for on the drawings.

E. Exterior structural framing (exposed to weather) shall be redwood No. 1 grade or pressure treated D.F. No. 1 or Western Cedar No. 1 grade, unless noted otherwise.

F. Structural decking shall be D.F. select decking or White Pine select where not exposed to moisture. Where directly exposed to moisture or high humidity for prolonged periods of time, decking shall be Alaskan Yellow Cedar. Moisture content at time of installation to be less than 12%.

G. Framing not otherwise shown or specified: Douglas Fir construction grade per WCLIB paragraphs applicable to uses and sizes required.

2.2 MANUFACTURED LUMBER

A. All engineered lumber to be maximum 16% at time of fastener installation and at time of close-in, unless noted otherwise.

B. Structural (Certified) Glued Lumber (SGL): SGL shall be manufactured following the American Lumber Standards Committee (ALSC) "Glued Lumber Policy" and meet the requirements of Voluntary Product Standard PS 20 "American Softwood Lumber Standard". Grading shall be by the West Coast Lumber Inspection Bureau (WCLIB) or Western Wood Products Association (WWPA). SGL shall be manufactured with waterproof adhesive. "Stud use only" SGL is not permitted.

1. Acceptable products:
   a. “RMT” by Rosboro.
   b. Approved equal.
2. Where specified for use on plan, SGL shall be entirely Douglas Fir lumber. SGL shall be grade marked to match the grade as would be specified for solid sawn lumber in the same location/use.
3. At the contractor's option, SGL may be substituted for solid sawn lumber. SGL species and grade shall match that for the solid sawn member. SGL shall not be substituted for glued-laminated (glulam) members.

C. Laminated Veneer Lumber (LVL): For use as joists, beams, blocking, or studs when so noted on the drawings. Conform to ICC AC 47. Minimum F_b = 2,600 PSI. Minimum E = 2,000,000 PSI. Acceptable products:

1. “Microllam LVL” by Trus Joist, ICC ESR-1387
2. “Redlam LVL” by RedBuilt, ICC ESR-2993
3. Approved equal

D. Laminated Strand Lumber (LSL): for use as blocking (flat or vertical) or rim joist when used with I-joist or LVL, when so noted on the drawings. Conform to ICC AC 124. Minimum F_b = 1,700 PSI. Minimum E = 1,300,000 PSI. Acceptable products:

1. “Timberstrand LSL” by Trus Joist, ICC ESR-1387
2. “RedBuilt LSL Rim Board” by RedBuilt, ICC ESR-1387
3. Approved equal

E. Parallel Strand Lumber (PSL): for use as beams and posts when so noted on the drawings. Conform to ICC AC 47. Minimum material properties for beams: E = 2,200,000 psi; F_b = 2,900 psi; F_c = 2,900 psi (parallel); F_v = 290 psi. Minimum material properties for posts: E = 1,800,000 psi; F_b = 2,400 psi; F_c = 2,500 psi (parallel); F_v = 190 psi. Acceptable products:

1. "Parallam PSL" by Trus Joist, ICC ESR-1387
2. Approved equal

2.3 STRUCTURAL SHEATHING PANELS

A. All sheathing to be maximum 16% at time of fastener installation and at time of close-in, unless noted otherwise.

B. Plywood: Structural sheathing shall conform to product standard PS-1 or PS-2. All panels shall have a minimum bond classification of "Exposure 1" and bear the trademark of the Engineered Wood Association (APA) or other qualified agency. Grades shall be "Rated Sheathing" or "Structural 1" as required on the drawings.

C. Oriented Strand Board (OSB): All structural OSB shall be grade marked by a qualified agency for conformance with Product Standard PS-2 and shall be fabricated with exterior glue. Grades shall be as required on the drawings.

2.4 TREATED WOOD:

A. Treated Lumber and Plywood: Comply with requirements of AWPA Standard U1. See Standard U1 for "Use Category" designations. Do not provide higher Use Category lumber than that specified. Maximum moisture content shall be the same as required above for respective product types.

B. Preservative Treated Lumber

1. General
   a. Preservatives shall be waterborne. Preservative retention rate shall be as required by AWPA Standards U1 & T1. Lumber shall be D.F. No. 2 (or better). Cut faces of treated wood shall be brush treated (two complete applications) prior to installation.
   b. Lumber less than 8 inches above grade and lumber less than 6 inches above exterior hard-surface flatwork shall be treated.
   c. Each piece of wood shall be stamped by the wood preservative applicator to identify its treatment and preservative retention.
2. Lumber at interior, non-weather exposed locations installed adjacent to concrete or masonry shall be Use Category UC2. Examples include sill plates & ledgers and lumber in contact with roofing, flashing, or water proofing. Borate treated lumber meeting AWPA UC2 is acceptable in this application.
3. Lumber at exterior locations, not in contact with soil/ground, shall be Use Category UC3B. Examples include Douglas Fir decking and deck framing.
4. Lumber in contact with soil/ground shall be Use Category UC4A. Examples include timber retaining walls.
5. Poles, posts, and sheathing panels shall be treated as recommended by AWPA Standard U1 per use and exposure.
6. Maximum Volatile Organic Compound (VOC) content of field-applied preservative shall meet local air quality standards and the California Green Building Code. Provide either of the following:
   a. Copper Azole (CA-B) per ICC-ES AC326.
   b. Alkaline/Copper/Quaternary (ACQ).

C. Fire Retardant Treatment: Product and application process must be recommended by manufacturer of treatment as being suitable for painting. Application shall be by a California State Fire Marshal approved licensed contractor.

1. Exterior Type: Use Category UCFB, chemically treated, and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
   a. Treat exposed exterior rough carpentry items, including stairways, balconies, and covered walkways.
   b. No structural lumber should be in direct contact with the ground, unless noted otherwise.

2. Interior Type: Use Category UCFA, low temperature (low hygroscopic) type, chemically treated, and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
   a. Treat rough carpentry items as indicated.
   b. Do not use treated wood in applications exposed to weather or where the wood may become wet.

2.5 FASTENERS AND ACCESSORIES

A. General requirements for fasteners:

1. Fasteners shall be of adequate size, spacing, and number to resist design loads under intended use, and types shall be appropriate for the materials or conditions for which used.
2. Provide washers, pre-drilling, etc. as required for proper installation and to prevent damage to framing.
3. Fasteners shall be hot dip galvanized (ASTM A153), mechanically galvanized (ASTM B695 class 55 minimum), stainless steel (type 303, 304, 305, or 316), silicon bronze, or copper by approved methods for the following applications:
   a. Exterior, exposed use.
   b. In contact with preservative or fire-retardant treated wood.
   c. Nails in contact with preservative treated wood containing ammonia shall be stainless steel.
4. Fasteners in moist corrosive atmosphere to be of stainless steel (type 303, 304, 305, or 316).
5. Where the retention level of ACQ or MCQ preservative is greater than 0.40 pcf, CBA-A preservative is greater than 0.41 pcf, or CA-B preservative is greater than 0.21 pcf, provide stainless steel fasteners (type 303, 304, 305, or 316).
6. All fasteners specified by the manufacturer shall be installed in framing hardware, unless noted otherwise.
7. At borate treated lumber, provide a clear zinc coating per ASTM F1941.

B. Nails and fastening not otherwise shown or specified:

1. Comply with requirements of governing building code.
2. For securing materials to hardened concrete or masonry provide hardened steel masonry nails or masonry screws.
3. For framing and general woodwork: Common bright wire nails (not box nails) with centered full-round heads per ASTM F1667 including Supplement S1. 16d cement coated sinker nails may be used in lieu of common nails for framing, where noted on the drawings. Unless otherwise noted on drawings, nail sizes shall be as follows
   a. 8d Common: 0.131”ø x 2-1/2” long with 0.281”ø head.

b. 10d Common: 0.148”ø x 3” long with 0.312”ø head.
c. 16d Common: 0.162”ø x 3-1/2” long with 0.344”ø head.

4. Nails for sheathing panels shall be of common wire with full round heads and shall be of sufficient length to fully develop the nails.
5. Machine-driven nails of all types must comply with the requirements of this section. All proposed nails shall match diameter and penetration of specified nails.
6. Staples shall conform to length and gauges specified and shall be installed to match specified patterns and spacing.
7. Power Actuated Fasteners (PAF): Use only as approved by the Architect/Engineer; operators shall be qualified.

C. Bolts: Malleable iron washers or steel plate washers, unless otherwise shown, shall be provided under all bolt heads and nuts.

1. Machine Bolts: ASTM A307 and ANSI/ASME B18.2.1, standard semi-finished machine bolts as shown or required. Nuts shall be standard size unless noted otherwise and shall be per ASTM A563.
2. Anchor bolts or threaded rod anchors shall conform to ASTM F1554, ASTM A307, or ASTM A36. Anchor bolts shall be headed or end in two nuts tightened against one another, unless noted otherwise. Provide embedded plate washer as indicated on drawings. No upset threads allowed. No L or J bolts are allowed.

D. Lag screws: Standard hex lag screws per ANSI/ASME B18.2.1.

E. Wood screws: Standard wood screws per ANSI/ASME B18.6.1.

F. Power Actuated Fasteners (PAF): Hilti X-CP72, ICC ESR-2379; Simpson PDPAWL-300 MG, ICC ESR-2138.

G. Framing hardware: Fabricated sheet metal timber framing connectors shall be manufactured from painted or galvanized G90 steel by Simpson Strong-Tie (connectors specified on drawings are per Simpson Strong Tie, or approved equivalent. Connectors shall be at least 16-gauge material, (1/8” plate materials where welded), unless otherwise noted, punched for nailing. All heavy hardware to be fabricated from A36 steel per Division 05, Metals. All hardware intended for exterior exposed use shall be galvanized per G185 ASTM A653 or stainless steel.

1. For contact with preservative or fire-retardant treated wood, provide minimum G185 galvanizing per ASTM A653.
2. Nails and nailing shall conform to the manufacturer’s instructions with a nail provided for each punched hole. Nails to be used with framing accessories are subject to the requirements specified in this Section for fasteners and anchors.

H. Subfloor Glue: Waterproof, water base, air cure type, cartridge dispensed conforming to APA Standard AFG-01 or ASTM D3498. Maximum Volatile Organic Compound (VOC) shall meet local air quality standards and the California Green Building Code.

2.6 SOURCE QUALITY CONTROL

A. The Testing Agency, as specified in the Article QUALITY ASSURANCE, will perform testing for moisture content of all lumber at time of fastener installation.

B. The Testing Agency will submit reports as specified in Division 01.

PART 3 - EXECUTION

3.1 REQUIREMENTS FOR STRUCTURAL FRAMING

A. General

1. Refer to drawings for layouts, notes and details, provide framing as required; comply with governing building code requirements.
2. Provide framing to achieve true alignments as surfaces receiving finish materials.
3. It shall be the responsibility of the Contractor to provide and install all wood blocking, furring strips, or grounds detailed or required to provide anchorage for all finishes, accessories, fixtures, etc. as required to complete all work. All blocking and/or backing shall be securely bolted or otherwise anchored in place.
4. Contractor shall be responsible for layout of anchor bolts, and other hardware embedded in concrete when placed by other trades.
5. Provide and install all structural framing, blocking, fasteners, brackets, clips, etc. as required to complete work specified in the Construction Documents.

B. Framing

1. Sill Plates and Ledgers:
   a. Sill plates and ledgers on concrete shall be anchored with bolts, unless noted otherwise, shall have full bearing on concrete, and shall be placed for sheathing panel nailing as indicated. All bolt nuts shall be provided with a cut plate steel washer for bearing on wood.
   b. Provide a minimum of two sill anchor bolts per sill piece with a bolt no less than 4-1/2” and no more than 12” from the end of the sill. Bolts to be 5/8" diameter x 12" (18” at curb) long at 48” on centers, unless otherwise shown or noted. Provide additional anchor bolts each side of a notch or hole, as per a typical plate splice, where notch or hole is in excess of one-third of the plate width. At shear walls, provide a plate washer 3” x 3” x 0.229” minimum between the sill and nut at anchor bolts. Plate washer to extend within 1/2” of the structural wall sheathing. Offset and/or stagger anchor bolts or provide larger plate washer as required. Anchor bolt shall be within the middle one-third of the sill plate and 2-1/2” minimum from the edge of concrete.
   c. Anchor bolt holes in sill plates or ledgers shall be 1/16" maximum larger than anchor bolt diameter.
2. Stud Walls and Framing:
   a. Cut studs and posts with square ends, unless otherwise shown or noted. All posts and beams shall be "cut to bear" unless otherwise detailed.
   b. All studs in walls shall be placed with the shortest dimension parallel to the run of the wall. Bearing studs shall extend full height to be the supporting framing as shown; non-bearing studs shall extend to the supporting framing.
   c. Provide double studs on each side of all openings, unless shown or noted otherwise.
   d. All openings in stud walls and partitions shall be framed with headers across the top, as shown, with a minimum size (6" nominal depth x stud width) resting on short cripple studs, and as shown on the drawings.
   e. All stud partitions and walls shall have horizontal solid blocking not less than 2x and of the same width as the stud, fitted and nailed into the studs at mid-height of stud, for studs over 8 feet in height, except as otherwise shown or specified. This blocking shall be so spaced that there shall be no concealed air spaces greater than eight feet in any dimension.

f. Stud partitions containing plumbing, heating or other pipes shall be framed to give proper clearance for piping. Plumbing, heating and vent pipes exceeding 1-1/2" in inside diameter shall not be placed in partitions used as bearing or shear walls unless completely furred clear of the wall. No notching shall be allowed. Pipes shall be placed in the center of the plate using a neat bored hole and the plates shall be strapped on each side with 3" x 36" x 14-gauge steel punched for 10d nails 3" on center, staggered, or as shown on the drawings.

3. Top Plates
   a. Top plates shall be double, set single. Corners where stud walls or partitions meet shall be framed with studs on all surfaces and blocking to form a "rigid" corner with nailing for all corners. Double top plates shall be lapped at corners. Lap splices and nailing per the drawings.
4. Floor, Roof and Ceiling Framing
   a. Joists and beams shall be accurately aligned and the position and spacing of all joists and beams shall be as shown and be coordinated with other framing and to other trades prior to actual construction.
   b. Place all joists and beams with crown up. Cantilevered joists and beams shall be placed with the crown down.
   c. Cutting of wood girders, beams or joists for electrical and mechanical lines shall be limited to cuts and bored holes not deeper than 1/5 of the beam depth from the top and located not farther from the support than three times the beam depth and not less than the beam depth. Cuts in excess of this, or single bored holes with a diameter of more than 1" are not permitted without special provisions for framing the beams. Location of all cuts in framing shall receive the prior review of the Architect/Engineer.
   d. Provide vent holes in rafters and/or blocking as shown and/or directed by the Architect.

3.2 STRUCTURAL SHEATHING

A. General

1. Sheathing nailing shall be as required on the drawings. Do not overdrive (Do not break skin of sheathing face sheet). Over driving will be cause for rejection.
2. Form sheathing may be re-used for concealed sheathing provided the lumber at the time of re-use is approved by the Architect, meets with the framing grade requirements specified herein, is in good condition, and is thoroughly cleaned with all nails removed.
3. Pneumatic nailing devices shall be adjustable so that nail heads do not penetrate skin of sheathing. Contractor shall submit equipment and nails for review prior to use. Refer to PART 2 for other nailing requirements.

B. Roof and Floor Sheathing: Except "Panelized Roofs", lay with face grain perpendicular to roof rafters, roof trusses or floor joists. Stagger sheets. Block all unsupported sheet edges with 2x material unless noted otherwise.

C. Wall Sheathing: Lay with face grain either parallel or perpendicular to studs. Exposed bottom edges shall be sealed as recommended by the manufacturer. Block all unsupported sheet edges with 2x materials unless noted otherwise.

D. Panelized Roofs: Where sheathing is set at 8'-1/8" spacing, cut every fourth sheet short by 1/2” to re-align structural framing that has been specified to be spaced at even units of 2, 4, or 8 feet.

3.3 ROUGH HARDWARE

A. General: Nails, spikes, screws, fabricated sheet metal anchors, ties, hangers and any other materials shown or required for the attachment of wood to concrete and wood to steel and wood to wood shall be furnished and installed as part of this work.

B. Framing Nailing: All framing nailing shall conform to minimum requirements of the Building Code, and with details shown on the drawing.

C. Bolts, Lag Screws and Washers:

1. Bolts in wood shall be machine bolts unless otherwise noted and shall be of such length that the bearing length of the threads does not exceed one-quarter of the full bearing length in the member holding the threads. Bolt holes in wood shall be 1/32" oversized. Holes in steel shall be 1/16" oversize. See Section 3.1 for anchor bolts at sill plates and ledgers.
2. Provide square plate or malleable iron washer and nut at head where bearing is against wood; cut washer under nut where it is against steel. Washer will not be required under head of carriage bolts. Provide malleable iron washers where exposed.
3. All nuts shall be tightened when placed and retightened at completion of the job or immediately before closing with final construction.
4. Lag screws shall be screwed (not driven) into place. Drill pilot hole to 70% of shank diameter. Drill clearance hole to full shank diameter and depth of unthreaded screw length.

D. Wood Screws: Minimum penetration is 10 diameters unless noted otherwise. Where fastening hardwood timber species or where wood tends to split, provide pilot hole 70% of screw shank diameter.

E. Proprietary Fasteners and Hardware: Install per manufacturer’s published installation instructions (MPII) and code approval report (e.g. ICC ESR, IAPMO ER, etc.). Provide MAX quantity, size, and length of fastener at hardware (i.e. joist hangers, framing, clips, etc) unless otherwise noted per plan.

3.4 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

A. Coordinate installation of wood decking, metal-web wood joists, glued-laminated wood construction, shop-fabricated wood trusses, and wood I- joists.

B. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members. Fasten curbs corner-to-corner and to rafters with framing connectors configured for this application.

C. Blocking:

1. Provide fire blocking at locations and spacing’s as required by CBC Chapter 7. Locate other blocking, supplementary framing, backing plates and bracing to facilitate installation of finish materials, fixtures, equipment, services, accessories, and trim requiring attachment and support.
2. Solid block joists and rafters over all supports with blocking of the same size and material as the joist or rafter.

D. Furring:

1. Nominal 1 inch x 3 inch minimum, continuous and spaced at 16 inches on center, maximum.
2. Install plumb, rigid, and level. Shim where necessary to provide a true, even plane suitable to receive the finish required.
3. Attach to concrete and masonry as shown in the contract drawings.

E. Bridging: Use 2-inch solid cross bridging. Nail bottom ends of bridging only after sheathing has been nailed.

F. Stair Framing: Provide with 3 stair stringers for each set of stairs, unless otherwise shown. Cut notches to receive exact size of treads and risers (if any) shown, with no change in dimensions between landings. Provide stringers of size shown, or if not shown, of a size to allow not less than 5- 1/2” of effective depth, measured perpendicular to the rake of the stringer, after notching.

G. Install miscellaneous metal angles, bolts, and other items; secure into formwork where embedded in concrete.

H. Install accessory items not otherwise set under other sections; after completion of painting and other finishing work; in locations shown or directed by the Architect. Set items plumb, level, and secure using appropriate fastening as applicable.

3.5 FIELD APPLIED WOOD TREATMENT

A. Field treat all end cuts and holes in preservative treated materials per PART 2.

B. Apply two brush coats; or full-immersion dip not less than 15 minutes; or as required to thoroughly saturate all surfaces after cutting.

C. Air dry 2 hours minimum before installation.

3.6 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

C. Variation from Plane (Other than Floors): 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum. Provide framed substrates meeting requirements for application of finishes specified in other sections.

D. Exposed surfaces shall be free from dents and tool marks, unsanded rough or torn faces and corners, and other defects.

3.7 FIELD QUALITY CONTROL

A. The Testing Agency, as specified in the Article QUALITY ASSURANCE, will perform the following tests and submit reports as specified in Division 01:

1. Moisture content of all lumber at time of close-in.
2. Periodic special inspection of nailing, bolting, and other fastening within the seismic-force-resisting system including shear walls, wood diaphragms, etc. per CBC Section 1705.13.2, excluding systems with sheathing nailing spacing greater than 4” on center.

3. Special inspection of high-load diaphragms per CBC Section 1705A.5.1 where designated on contract documents.

3.8 ADJUSTING

A. Replace all defective work at Contractor's expense.

B. Replace defective or damaged work with conforming work.

C. Correct defects using means that will not injure the materials.

D. Replace defective or damaged work which cannot be corrected in the field with new work or return defective items to the shop for repair.

E. Repair or replace framing lumber sagged, twisted or warped due to shrinkage from excessive moisture content at time of installation, or from other causes.

F. Adjust to meet specified tolerances.

G. Architect/Engineer shall review all proposals for the repair or replacement of damaged, defective, or missing work.

H. Pay expenses incurred by Owner for Architect/Engineer's costs for (re-)design and obtaining approvals of Authorities Having Jurisdiction (AHJ) necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work.

I. Pay expenses due to re-testing and re-inspection necessitated by incomplete, inefficiently scheduled, improperly performed, defective or nonconforming work.

3.9 CLEANING AND PROTECTION

A. Clean all surfaces upon completion of erection, leave free of grime and dirt. Remove unused materials, tools, equipment, and debris from the premises and leave surfaces broomed clean.

B. Waste Disposal: Comply with the requirements of pertinent sections of Division 01 specifying cleaning and disposal.

1. Comply with applicable regulations.
2. Do not burn scraps on project site.
3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

C. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

D. Prevent sawdust and wood shavings from entering the storm drainage system.

E. Protect work from damage by subsequent operations.

END OF SECTION 06 10 00

SECTION 06 18 00

GLUED LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: All labor, materials and equipment for glued laminated timber necessary to complete work shown, implied, specified and required.

B. Related Sections:

1. Pertinent sections of Division 01 specifying Quality Control and Testing Agency services.
2. Pertinent section of Division 06 specifying wood construction and materials.

1.2 REFERENCES

A. California Code of Regulations, Title 24, latest adopted edition (herein noted as CBC): Chapter 23 Wood.

B. American National Standards Institute (ANSI) A190.1 “Standard for Wood Products - Structural Glued Laminated Timber”.

C. ANSI 117 “Standard Specification for Structural Glued Laminated Timber of Softwood Species”.

D. American Society for Testing and Materials (ASTM) D3737 “Standard Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam)”.

1.3 SUBMITTALS

A. Submit in accordance with pertinent sections of Division 01 specifying submittal procedures. The General Contractor shall review and approve shop drawings prior to submittal to the Architect/Engineer. Submittals that do not meet these requirements will be returned for correction without review.

B. Limitation of Review: Structural Engineer’s review will be for general conformance with design intent as indicated in the Contract Documents and does not relieve Contractor of full responsibility for conformance with the Contract Documents.

C. Shop Drawings: Submit each building as a complete unit. Do not mix components from multiple buildings or units of work in a submittal. Include all of the following:

1. Indicate profiles, sizes, lengths, appearance grade, and locations of structural members. Indicate adhesive type and sealer application area(s).
2. Cross-reference all shop drawing detail references to contract document detail references.
3. Secure all field measurements as necessary to complete this work, prior to submittal.

D. Certifications:

1. ANSI/AITC Certificate of Conformance.

2. Special Inspection Certification.

E. Warranty:

1. Two copies of a five-year warranty, signed by an officer of the manufacturer, shall be submitted to the Architect/Engineer stating that the workmanship shall be corrected to the satisfaction of the Architect/Engineer at no cost to the Owner.

1.4 QUALITY ASSURANCE

A. Each glued laminated member shall bear the ANSI/AITC Quality Mark to indicate conformance to ANSI A190.1.

B. All tests shall be performed by a recognized testing agency as specified in pertinent sections of Division 01.

C. Certification and Identification of Materials and Uses: Provide Testing Agency with access to fabrication plant to facilitate inspection of fabrication. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection and all material identification.

D. Testing and Inspection: Tests and Inspections performed by Independent Testing Agency are specified below in Article SOURCE QUALITY CONTROL. Duties and limitations of Independent Testing Agency, test costs, and test reports to be in conformance with pertinent sections of Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber

1. Conform to ANSI/AITC 117.
2. Laminations shall be 2 inch nominal thickness unless otherwise noted.
3. 16% maximum moisture content (MC) at time of manufacture.

B. Adhesive: Shall be exterior grade for wet surface condition above 16% and shall meet requirements of ANSI 405.

C. Interior use glue laminated members shall be manufactured entirely from Douglas Fir.

1. Simple span beams shall be combination 24F-V4-1.8E.
2. Beams with intermediate supports and/or cantilevers shall be combination 24F-V8-1.8E.
3. Posts and truss members shall be combination 3-1.9E.

D. Glue laminated members that are protected from weather by a roof, eave, or similar covering may be Douglas Fir. The ends shall be flashed and treated with approved wood preservative to prevent decay.

E. Glue laminated members with exterior exposure shall be fabricated entirely from Alaskan Yellow Cedar (AYC). No sap wood permitted.

1. Simple span beams shall be combination 20F-V12-1.5E.
2. Beams with intermediate supports and/or cantilevers shall be combination 20F-

V13-1.5E.

3. Posts and truss members shall be combination 71-1.6E.

F. Radial Tension Reinforcement: ANSI/AITC 404.

2.2 CAMBER

A. All beams shall be cambered as noted on the drawing. Where no camber is noted, provide 5,000 ft radius camber at simple span beams.

B. Cambers specified shall be provided within tolerances per ANSI A190.1. The Contractor shall verify all beam cambers prior to erection and report their findings in writing to the engineer for review and comment.

2.3 APPEARANCE

A. Glued laminated members shall be Industrial Appearance Grade when not exposed to permanent view and Architectural Appearance Grade otherwise. Appearance to meet the requirements of ANSI A190.1.

2.4 PROTECTION

A. Protection during shipping and field handling to meet requirements of AITC 111, including protective wrapping and proper storage of members to prevent increased moisture content and damage. Individually wrap members with Architectural Appearance Grade.

B. Ends shall be sealed after end trimming and entire surface of members shall be factory sealed with a penetrating sealer that has been approved by the Architect. Field cuts, notches, and daps shall receive one coat of the same sealer prior to erection.

2.5 SOURCE QUALITY CONTROL

A. Special Inspection is not required for non-custom members with maximum 6-inch nominal width, maximum 18-inch depth, and maximum 32 feet clear span per CBC section 1705A.5.5. Provide an ANSI/AITC certificate for each member.

B. Members not meeting the above criteria shall be continuously inspected during fabrication by a glue fabrication inspector specifically approved for that purpose. The Inspection shall conform to CBC requirements. An ANSI/AITC Certificate will not meet this requirement.

1. An independent Testing Agency will perform source quality control tests and submit reports, as specified in pertinent sections of Division 01 and CBC Chapter 17A.
2. The inspector shall issue four copies of certificates to the Architect/Engineer certifying that materials, manufacture and fabrication are in accordance with these Specifications and the Drawings and shall specify the following:
   a. Species, grade and slope of grain of lumber. Lumber grading inspection shall be done by lumber graders authorized under the provisions of the American Lumber Standards Committee and verified by the special independent inspector.
   b. Glue quality specified.
   c. Glue bond over entire surface.
   d. Continuous inspection of gluing operation.
   e. Moisture content of laminations during manufacture.

f. Finger joint locations.
g. All requirements of ANSI A190.1 are met.

3. Each inspected member shall be stamped by the special inspector with an identification mark.

PART 3 - EXECUTION

3.1 ERECTION

A. Members shall be seat cut to bear, dapped, etc. as detailed on the drawings prior to erection.

B. Members shall be erected with suitable equipment and secured in place as detailed on the drawings.

C. Glued laminated members shall be aligned and braced until all secondary members or other framing is secured. The contractor shall verify all beam cambers in the field prior to erection.

3.2 CLEANING

A. All debris resulting from this portion of the work shall be removed from the site upon completion.

B. Protect work from damage by subsequent operations.

END OF SECTION 06 18 00

SECTION 12 93 05 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install all manufactured items shown on drawings and specified.

B. Scope of work - The general extent of work contained in this section is shown on the Drawings and can include, but may noat be limited to, installation of the following:

1. Items specified here in and shown on the drawings

C. Related sections can include, but may not be limited to the following:

1. Section 00 31 19, Existing Conditions
2. Section 00 31 32, Geotechnical Data
3. Section 01 11 00, Summary of Work
4. Section 02 41 00, Site Preparation and Plant Protection
5. Section 31 00 00, Earthwork
6. Section 32 11 13, Subgrade Preparation & Base Material
7. Section 33 40 10, Storm Drainage

1.2 REFERENCES AND REGULATORY REQUIREMENTS

A. State of California Department of Transportation Standard Specifications, current edition.

B. Perform all work in accordance with all applicable laws, codes, and regulations required by the State of California, the City of San Mateo and the County of San Mateo.

1.3 SUBMITTALS

A. Conform to applicable specifications, General Conditions and/or Special Provisions.

B. Product Data: Submit catalog “cut sheets” and installation instructions of all materials and equipment proposed to be furnished and/or installed under this portion of the work. Include the manufacturers and distributors name, sub-contractor as applicable. Ensure that the “cut sheets” clearly describe the specific product by catalog number and that additional non-specified products that may appear on the same “cut sheet” are cross out where applicable.

C. Samples: Submit samples of colors and finishes for all applicable products and furnishings for selection by District. Submit sample of sand.

D. Shop Drawings: Submit complete shop drawings for all materials or furnishings requiring field or shop fabrication. Provide complete drawings for sand catchers.

1.4 QUALITY ASSURANCE

A. All Site Furnishings sub-contractors bidding on this project must have a California license and be experienced in the installation, in Northern California, of tennis court surfacing, and tennis court installation and striping for at least 5 years and have completed five (5) projects in Northern California of comparable size, type and complexity, in the past three (3) years.

B. Review: All equipment shall be reviewed for conformance with the intent of the Contract Documents and accepted by the contractor prior to installation. All site furnishings shall be in a new, “first-class” condition, per the discretion of the District’ Representative, prior to Final Acceptance.

1.5 DELIVERY, STORAGE AND HANDLING

A. The contractor is responsible for coordination of the delivery, acceptance, handling and storage of all site furnishings.

B. Store and handle site furnishings as acceptable to the Construction Manager and so that work or access of others is not impeded.

C. The contractor shall protect all site furnishings from theft or damage at all times until the District’s Representative has accepted such items.

1.6 SOILS REPORT

A. A soil investigation reports has been prepared for the project. See Section 00 31 32 Geotechnical Data.

B. The reports are available in the office of the Landscape Architect and the Construction Manager for inspection by the Contractor. Unless otherwise specified, it is intended that all work be performed in accordance with the provisions of these reports.

C. Drilled piers may encounter ground water. Excavations for drilled piers may require casings and installation of concrete by means of pumping under the direction of the Geotechnical Engineer.

1.7 SOILS BORINGS

A. Subsurface soils investigations have been made at the site and logs of the test holes are available with the Soils Report. Such investigations have been made for the purposes of design only, and neither the Landscape Architect, the Owner, nor the Soils Engineers guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations.

PART 2 - MATERIALS

2.1 SITE FURNISHINGS

Description	Mfr	Model No.	Finish/Color	Distributor/ Contact
Benches	Per Drawings	Per Drawings	Per Drawings	Per Drawings
Waste receptacles	Per Drawings	Per Drawings	Per Drawings	Per Drawings

2.2 OTHER EQUIPMENT

A. As shown on drawings or accepted equal.

2.3 LOCKS and KEYS

A. All lock keys shall be keyed alike. Provide locks keyed alike to what the school uses.

PART 3 - EXECUTION

3.1 SEQUENCING AND SCHEDULING

A. Coordinate construction timing of installation of site furnishings in conformance with all other work.

3.2 INSTALLATION

A. Install as shown in Drawings and per manufacture’s requirements unless noted otherwise.

B. Equipment:

1. Conform to layout shown on Drawings.

2. Erect site furnishings in strict conformance with details, accepted Shop Drawings, and manufacturer’s instructions. If specified equipment and/or materials are revised, plans and Drawings are subject to revisions based on manufactures.

3. If specified equipment and/or materials are revised, plan and Drawings are subject to revisions based on manufacturers’ recommendations.

C. Install manufactured items in accordance with the manufacturer's instruction and as shown in the drawings and as specified herein.

D. Set all work true and square, plumb and level.

E. Size bolts to fit flush with nuts. Countersink nuts and bolts as detailed. Vandal proof bolts as directed by Project Inspector.

F. Securely fasten and/or anchor all equipment with bolts, angles, plates, flanges, concrete footings and/or other items required for proper and complete installation and/or erection of the units.

G. Supply all miscellaneous metal units and install as specified herein.

H. Install all equipment in strict conformance with the manufacturer's specifications and/or as accepted by the Landscape Architect.

I. Set all equipment, etc., level as recommended by manufacturer.

J. Transport, store and handle precast units and manufactured items in a manner to avoid hairline cracks, staining or other damage. Store units free of the ground and protected from mud or rain splashes. Cover units, secure covers firmly, and protect the units from dust, dirt or other staining material.

3.3 FIELD QUALITY CONTROL

A. All site furnishings shall be inspected and accepted upon delivery by the Contractor. Final acceptance of site furnishings and locations of site furnishings shall be per the discretion of the Landscape Architect.

3.4 CLEANUP: Per General Conditions.

A. During construction, protect work from damage by accident, staining or otherwise.

B. Upon completion, repair or replace broken, damaged or defective parts.

C. Remove all surplus materials and debris from the premises.

D. All work shall be left in a condition satisfactory to the Landscape Architect.

3.5 CLOSEOUT

A. Include manufacture’s cut sheets and maintenance instructions of specified items in Operations and Maintenance Manual.

B. Include manufacture’s warranty information of specified items with warranties.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of existing trees and vegetation

B. Clearing vegetation, debris, trash and other materials within limits indicated

C. Grubbing of vegetation within limits indicated

D. Stripping of topsoil within limits indicated

E. Removing above-grade site improvements within limits indicated

F. Disconnecting, capping or sealing, and abandoning site utilities in place

G. Disconnecting, capping or sealing, and removing site utilities

H. Disposing of objectionable material

1.2 RELATED SECTIONS

A. Section 31 20 00, Earth Moving

B. Section 32 12 16, Asphalt Paving

C. Section 32 13 13, Concrete Pavement

1.3 RELATED DOCUMENTS

A. Geotechnical Report: ***[Insert Report Title, Company, and Report Date]***.

B. ANSI A300: Industry Standards for Tree Care Practices

C. Applicable Publications
   1. "Trees and Building Sites," official publication of the International Society of Arboriculture.
   2. "Arboriculture," the care of trees and shrubs by Dr. Richard Harris.

1.4 DEFINITIONS

A. ANSI: American National Standards Institute

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 01 10 00, Supplemental General Requirements.

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 A300.

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. Salvageable 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 engineered fill defined in Section 31 20 00, Earth Moving.

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 REMOVAL

A. Remove trees designated for removal prior to the construction of new improvements in the vicinity:

1. When demolishing trees indicated to be removed within areas for new pavement or hardscape, remove tree, stump to a depth of two (2) feet below finish grade, and all roots located in the top twelve (12) inches of soil. Remove wood chips created from grinding process down to remaining stump then refill void and re-compact to 80% relative compaction. Use import soil as indicated in specifications for this purpose. Import soil and compaction in future paved areas shall be in accordance with Section 32 12 16, Asphalt Paving and Section 32 13 13, Concrete Pavement.

2. When demolishing trees indicated to be removed within new landscaped areas, removal shall be done in one of the following ways:
   a. For trees located in accessible areas, remove tree and grind stump to four (4) inches below finish grade. Backfill the void and re-compact to 80% relative compaction. Use import soil as indicated in specifications for this purpose. Do not remove existing roots.
   b. For trees located in inaccessible areas, cut stump flush with finish grade, and cover with 3 inches of bark mulch. Do not grind the stump and do not remove existing roots.

B. Perform tree removal work in a safe and proper manner, adhering to CAL-OSHA tree work protection standards and ANSI A300 Standards.

C. All trees to be demolished shall be removed in such a way as to not damage branches, trunks, or root systems of adjacent trees.

3.3 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.

3.4 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 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. Fill abandoned piping with cement slurry.

H. Securely close ends of abandoned piping with tight fitting plug or cement slurry minimum 6 inches thick.

3.5 CLEARING AND GRUBBING

A. Areas to be graded shall be cleared of existing vegetation, rubbish, existing structures, and debris.

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

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

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

3.6 SITE STRIPPING

A. Strippings and spoils shall be disposed at an off-site location, per geotechnical recommendations.

B. Remove vegetation before stripping soil.

C. Surface soils that contain organic matter should be stripped. In general, the depth of required stripping will be relatively shallow (i.e. less than 2 inches); deeper stripping and grubbing may be required to remove isolated concentrations of organic matter or roots.

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

E. Stockpile soil 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.

F. Do not stockpile soil within drip line of remaining trees.

3.7 SITE IMPROVEMENTS

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

3.8 BACKFILL

A. Place and compact material in excavations and depressions remaining after site clearing in accordance with Section 31 20 00, Earth Moving.

3.9 DISPOSAL

A. Remove surplus soil material, unsuitable soil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the Owner's property.

END OF SECTION

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SECTION 31 20 00

EARTH MOVING

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, building pads, 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 shall be performed in accordance with Sections 31 21 00, Utility Trenching and Backfill.

1.3 RELATED SECTIONS

A. Section 01 10 00, Supplemental General Requirements

B. Section 01 50 50, Erosion Control

C. Section 31 10 00, Site Clearing

D. Section 31 23 19, Dewatering

E. Section 33 46 00, Subdrainage

1.4 RELATED DOCUMENTS

A. Geotechnical Report: ***[Insert Report Title, Company, and Report Date].***

B. ASTM
1. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
2. D1586, Method for Penetration Tests and Split-Barrel Sampling of Soils
3. D2487, Classification of Soils for Engineering Purposes
4. D3740, Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
5. D4318. Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
6. E329, Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
7. E548, Guide for General Criteria Used for Evaluating Laboratory Competence

C. California Building Code, California Code of Regulations, Title 24, Part 2, Chapter 18, Soils and Foundations, and Chapter 33, Safeguards During Construction

D. Caltrans Standard Specifications, 2015
1. Section 17, General
2. Section 19, Earthwork

E. CAL/OSHA, Title 8.

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 Engineer.
   2. Unauthorized Over-Excavation: Excavation below subgrade elevations or beyond indicated horizontal dimensions without authorization by the Geotechnical Engineer. Unauthorized excavation shall be without additional compensation.

C. Geotechnical Testing Agency: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock definition testing, as documented according to ASTM D3740 and ASTM E548.

D. Structural Backfill: Soil materials approved by the Geotechnical Engineer and used to fill excavations resulting from removal of existing below grade facilities, including trees.

E. Structural Fill: Soil materials approved by the Geotechnical Engineer 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 D1586, 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. 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.

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

K. Relative Compaction: In-place dry density of soil expressed as percentage of maximum dry density of same materials, as determined by laboratory test procedure ASTM D1557.

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

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.

B. Samples:
1. If required by the Geotechnical Engineer, provide 20 pound samples, sealed in airtight containers, tagged with source locations and suppliers of each proposed soil material from on-site or borrow sources, 72 hours prior to use. Do not import materials to the Project without written approval of the Geotechnical Engineer.
2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Engineer.

C. Material Test Reports: Provide, from a qualified testing agency, the following test results showing compliance with the project requirements: ***[Include this paragraph only if Owner will not have a Geotechnical Engineer on-site during construction.]***

D. Classification according to ASTM D2487 of each onsite or borrow soil material proposed for fill and backfill.
1. Laboratory compaction curve in conformance with ASTM D1557 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 E329 to conduct soil materials and rock definition testing, as documented according to ASTM D3740 and ASTM E548. ***[Include this paragraph only if Owner will not have a Geotechnical Engineer on-site during construction]***

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

C. Conform all work in accordance with Caltrans Standard Specification Section 17, General and Section 19, Earthwork.

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 D1557.

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

F. The Geotechnical Engineer 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 Engineer, 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 Engineer have been displaced or are otherwise unsatisfactory due to the Contractor's operations.

H. Finish subgrade tolerance at completion of grading:
1. Building and paved areas: ±0.05 feet
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 in accordance with Section 01 50 50, Erosion Control.

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

E. 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: On-site soils are considered suitable for use as fill provided the materials are placed in accordance with Geotechnical Recommendations. Highly expansive soils shall not be used as select structural fill, or used as backfill for trenches located within hardscape areas.

B. Imported fill soils, if required, should be predominantly granular in nature, and should be free of organics, debris, or rocks over 3 inches in size, and shall be approved by the Geotechnical Engineer before importing to the site. Imported non-expansive soils shall have a Plasticity Index less than 15 as determined by ASTM D4318, an R-value of at least 20, and fines content between 15 and 65 percent. Import fill shall be

considered non-hazardous per Department of Toxic Substances Control guidelines (DTSC, 2017) and non-corrosive per Caltrans Corrosion Guidelines (Caltrans, 2015).

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. Perform work in accordance with Caltrans Standard Specification Section 19, Earthwork, 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.

D. Grading and earthwork operations shall be observed and tested by a representative of the Geotechnical Engineer for conformance with the project plans/specifications and the geotechnical recommendations. This work includes site preparation, selection of satisfactory materials, and placement and compaction of the subgrades and fills. Sufficient notification prior to commencement of earthwork is essential to make certain that the work will be properly observed.

3.2 CONTROL OF WATER AND DEWATERING

A. Comply with Section 31 23 19, Dewatering, if dewatering is necessary.

B. 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.

C. Dewater during backfilling operation so that groundwater is maintained a least 1 foot below level of compaction effort.

D. Obtain the Geotechnical Engineer’s approval for proposed control of water and dewatering methods.

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

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

G. 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 Engineer allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the Geotechnical Engineer.

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 Engineer, 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 TOPSOIL STRIPPING

A. Remove topsoil in accordance with Section 31 10 00, Site Clearing.

3.6 EXCAVATION

A. Excavate earth and rock to lines and grades shown on plans 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. Excavation through buried concrete and other unknown obstructions will require specialized techniques for demolition and removal.

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

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

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. Subgrade Preparation: Prior to backfilling depressions created by the removal of old foundations and utility lines, scarify the bottom of the excavation to an approximate depth of 8 inches and uniformly moisture condition the scarified surfaces to a moisture content that is at least 2 percent over optimum. Compact the scarified surfaces to a minimum of 90 percent relative compaction at above optimum moisture content.

B. Over-excavate any remaining soft (pumping) areas down to firm soil and backfill the area.

C. Subgrade shall be maintained in a moist, but not wet, condition by periodically sprinkling water prior to the placement of additional fill or installation of roads. Subgrade that has been permitted to dry out and loosen or develop desiccation cracking should be scarified, moisture conditioned, and re-compacted as recommended above.

D. 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.

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

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

G. Obtain the Geotechnical Engineer’s approval of subgrades prior to placing pavement structural section.

3.9 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 Engineer.

B. Place subsurface drains in bottom of keyway in accordance with Section 33 46 00, Subdrainage.

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 Engineer.

3.10 LOT FINISH GRADING

A. Blade finish lots to lines and grades indicated.

3.11 FILL PLACEMENT AND COMPACTION

A. Place fill in uniformly moisture conditioned and compacted lifts not exceeding 8 inches in loose thickness. Each lift should be thoroughly moisture conditioned and compacted to 90 percent before successive fill layers are placed.

B. In order to achieve satisfactory compaction in the subgrade and fill soils, it may be necessary to adjust the soil moisture content at the time of soil compaction per geotechnical recommendations. This may require that water be added and thoroughly mixed into any soils which are too dry or that scarification and aeration be performed in any soils which are too wet.

C. Obtain the Geotechnical Engineer's approval of surface to receive structural fill prior to placement of structural fill material.

D. Place structural fill on prepared subgrade.

E. 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.

F. Do not compact by ponding, flooding or jetting.

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

H. Compaction requirements (unless specified otherwise by the Geotechnical Engineer):
   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 Engineer.
   4. Compact the upper 6 inches of subgrade soils under walks, structures and areas to receive structural fill to 90 percent compaction.

3.12 SOIL STERILIZATION

A. Apply soil sterilant to areas indicated, such as beneath asphalt concrete pavement, brick pavement, concrete 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.

3.13 DISPOSAL

A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Owner.

END OF SECTION

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SECTION 31 21 00

UTILITY TRENCHING AND BACKFILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Excavation, bedding, and backfill for underground storm drain, sanitary sewer, and water piping, underground HVAC piping, electrical conduit, telephone conduit, gas piping, cable TV conduit, etc., and associated structures.

B. Provide labor, material, equipment, and services necessary to complete the backfilling and compacting as necessary for this project. Section includes, but is not limited to:
1. Select Backfill Material
2. Aggregate Base
3. Detectable Tape
4. Trench Excavation
5. Pipe Bedding
6. Trench Backfill
7. Trench Surfacing

C. This section excludes drainage fill material and placement around subdrains. See Section 33 46 00 – Subdrainage.

1.2 RELATED SECTIONS

A. Section 31 10 00 – Site Clearing

B. Section 31 20 00 – Earthwork Moving

C. Section 31 23 19 - Dewatering

D. Section 33 10 00 – Water System

E. Section 33 30 00 – Sanitary Sewer System

F. Section 33 41 00 – Storm Utility Drainage Piping

G. Section 33 46 00 – Subdrainage

1.3 RELATED DOCUMENTS

A. Geotechnical Report: ***[Insert Report Title, Company, and Report Date]***.

B. ASTM
1. D1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
2. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications.

C. California Administrative Code, Title 24, Part 2 - Basic Building Regulations, Chapter 24, Excavations, Foundations, and Retaining Walls.

D. Caltrans Standard Specifications, 2015
   1. Section 19, Earthwork
   2. Section 26, Aggregate Bases
   3. Section 68, Subsurface Drains
   4. Section 96, Geosynthetics

E. CAL/OSHA, Title 8

1.4 DEFINITIONS

A. AC: Asphalt Concrete

B. ASTM: American Society for Testing and Materials

C. Base: The layer placed between the subgrade and surface pavement in a paving system.

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

E. CDF: Controlled Density Fill

F. DIP: Ductile Iron Pipe

G. Engineered Fill:
   1. Soil or soil-rock material approved by the Owner and transported to the site by the Contractor in order to raise grades or to backfill excavations.
   2. Contractor shall provide sufficient tests, and a written statement that all materials brought onto the project site comply with specification requirements.

H. Excavation: Consists of the removal of material encountered to subgrade elevations

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

J. PCC: Portland Cement Concrete

K. RCP: Reinforced Concrete Pipe

L. Relative Compaction: In-place dry density of soil expressed as percentage of maximum dry density of same materials, as determined by laboratory test procedure ASTM D1557.

M. 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.

N. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below base.

O. Subsequent Backfill: Material from 12 inches above top of pipe to subgrade of surface material or subgrade of surface facility or to finish grade.

P. 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 Engineer.
   2. Unauthorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions without authorization by the Geotechnical Engineer. Unauthorized excavation shall be without additional compensation.

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

1.5 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 10 00 – Supplemental General Requirements.

B. Test Reports: Submit the following report for import material directly to the Owner from the Contractor's testing services:
   1. Compaction test reports for aggregate base.

C. Samples:
   1. If required by the Geotechnical Engineer, provide 20-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 Engineer and the Owner.
   2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Engineer and the Owner.

1.6 QUALITY ASSURANCE

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

B. Conform all work to the appropriate portion(s) of the Caltrans Standard Specifications, Section 19, Earthwork.

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.
[Use either Article D or E depending on whether the Owner or the Contractor will be performing the soil testing.]

D. The Geotechnical Engineer 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 Engineer, does not meet the requirements of these Technical Specifications and the Geotechnical Report.

E. Soil Testing:

1. Contractor to engage a geotechnical testing agency, to include compaction testing and for quality control testing during fill operations.
2. Test results will be submitted to the Owner.

1.7 PROJECT CONDITIONS

A. Promptly notify the Owner of surface or subsurface conditions differing from those disclosed in the Geotechnical Report. First notify the Owner 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 in writing of differing conditions prior to contractor starting work on affected items.

B. Barricade open excavations and post with warning lights.
1. Operate warning lights and barricades as required.
2. Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations, from damages caused by settlement, lateral movement, undermining, washout, and other hazards.
3. 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 01 10 00 Supplemental General Requirements.

E. Environmental Requirements:
1. Protect existing storm drainage system from silt and debris resulting from construction activities. If contamination occurs, remove contamination at no cost to the District.
2. Protect existing streams, ditches and storm drain inlets during work on this project.

F. Protection of Subgrade: Do not allow equipment to pump or rut subgrade, stripped areas, footing excavations, or other areas prepared for project.

G. Transport all excess soils materials by legally approved methods to disposal areas.
1. Coordinate with the Engineer.
2. Any additional fill requirements shall be the responsibility of the Contractor.

1.8 EXISTING UTILITIES

A. Locate existing underground utilities in the areas of work. For utilities that are to remain in place, provide adequate means of protection during excavation operations.
1. Locating of existing underground utilities shall include but not be limited to pot-holing prior to the start of construction.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Owner and/or utility agency immediately for directions.
1. Cooperate with the Owner and public and private utility companies in keeping their respective services and facilities in operation.
2. Repair damaged utilities to the satisfaction of the agency with jurisdiction.

C. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Owner and then only after acceptable temporary utility services have been provided.

PART 2 - PRODUCTS

2.1 GENERAL

A. Import materials will be subject to approval of the Geotechnical Engineer.

B. For approval of imported fill material, notify the Owner at least 7 days in advance of intention to import material.

2.2 PIPE BEDDING AND INITIAL BACKFILL

A. ASTM D2321, Class IA, IB or II.
1. Clean and free of clay, silt or organic matter.

B. Permeable Material: In accordance with Section 68-2.02F of Caltrans Standard Specifications, Class 1, Type A or Class 2.

C. Class 2 Aggregate Base: In accordance with Section 26 of Caltrans Standard Specifications, ¾ inch maximum.

D. Sand: In accordance with Section 19-3.02F of Caltrans Standard Specifications.

2.3 SELECT BACKFILL

A. Select backfill material shall be gravel, free of clay or organic matter and shall conform to the following gradation:

Sieve Size	Percentage Passing
1 inch	100
¾ inch	90 – 100
No. 4	35 – 60
No. 200	2 - 9

B. For gas pipe and fuel piping select backfill shall be clean, graded building sand conforming to the following gradation:

Sieve Size	Percentage Passing
No. 4	100
No. 200	0 -5

2.4 WARNING TAPE

A. Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.
1. Warning Tape Color Codes

a. Red: Electric
b. Yellow: Gas, Oil; Dangerous Materials
c. Orange: Telephone and Other Communications
d. Blue: Water Systems
e. Green: Sewer Systems
f. White: Steam Systems
g. Gray: Compressed Air

2. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.
3. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.5 DETECTION WIRE FOR NON-METALLIC PIPING

A. Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

2.6 SUBSEQUENT BACKFILL

A. Conform to on-site or imported structural backfill in Section 31 20 00, Earth Moving.

2.7 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 C150, Type II Cement.

C. Fly Ash: Conform to the standards as set forth in ASTM C618, 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 C260.

E. Aggregates need not meet the standards as set forth in ASTM C33. 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 Engineer's approval.

2.8 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 Engineer.

B. Poured-in-Place Structures:
1. Bedding: Bedding shall meet the approval of the Geotechnical Engineer. 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 31 20 00, Earth Moving.

2.9 GEOSYNTHETICS

A. Filter Fabric:
1. Filter Fabric: Section 96-1.02 of Caltrans Standard Specifications.
2. Mirafi 140N, Mirafi Inc., or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the recommendations of the Geotechnical Engineer.

B. Protect existing trees to remain. No grading is permitted under the drip line of protected trees.

C. Excavations for appurtenant structures, such as, but not limited to, manholes, transition structures, junction structure, vaults, valve boxes, catch basins, thrust blocks, and boring pits, shall be deemed to be in the category of trench excavation.

D. Unless otherwise indicated in the Plans, all excavation for pipelines shall be open cut.

E. Prior to commencement of work, become thoroughly familiar with site conditions.

F. In the event discrepancies are found, immediately notify the Owner in writing, indicating the nature and extent of differing conditions.

G. Backfill excavations as promptly as work permits.

H. Do not place engineered fill or backfill until rubbish and deleterious materials have been removed and areas have been approved by the Owner.

I. Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.

J. In excavations, use satisfactory excavated or borrow material.

K. Under grassed areas, use satisfactory excavated or borrow material.

3.2 SITE PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, which are to remain, from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect existing storm drainage system from silt and debris resulting from construction activities. If contamination occurs, remove contamination at no cost to the Owner.

3.3 EXISTING UTILITIES

A. Identity the location of existing utilities.
1. Prior to trenching, the Contractor shall excavate at locations specifically indicated on the Plans, if any, and where new lines cross other utilities of uncertain depth and determine the elevation of the utility in question to ensure that the new line will clear the potential obstruction.
2. The Contractor shall contact Underground Service Alert (USA) at 1-800-227-2600 for assistance in locating existing utilities.
3. If, after the excavation, a crossing utility does present an obstruction, then the line and grade of the new line will be adjusted as directed by the Owner to clear the utility.

B. Protect all existing utilities to remain in operation.

C. Movement of construction machinery and equipment over existing pipes and utilities during construction shall be at Contractor's risk.

D. Excavation made with power-driven equipment is not permitted within 2 feet of any known utility or subsurface structure.
1. Use hand or light equipment for excavating immediately adjacent to known utilities or for excavations exposing a utility or buried structure.
2. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured.
3. Support uncovered lines or other existing work affected by excavation until approval for backfill is obtained.
4. Report damage of utility line or subsurface structures immediately to the Owner.

E. Backfill trenches resulting from utility removal in lifts of 8 inches maximum.

3.4 TRENCH EXCAVATION

A. General
1. Excavation shall include removal of all water and materials that interfere with construction. The Contractor shall remove any water which may be

encountered in the trench by pumping or other methods during the pipe laying, bedding and backfill operations. Material shall be sufficiently dry to permit approved jointing.

2. Excavation shall include the construction and maintenance of bridges required for vehicular and pedestrian traffic, support for adjoining utilities.
3. The Contractor shall be responsible to safely direct vehicular and pedestrian traffic through or around his/her work area at all times.
4. The Contractor shall relocate, reconstruct, replace or repair, at his/her own expense, all improvements which are in the line of construction or which may be damaged, removed, disrupted or otherwise disturbed by the Contractor.

B. Existing Paving and Concrete:
1. Existing pavement over trench shall be sawcut, removed, and hauled away from the job. Existing pavement shall be neatly sawcut along the limits of excavations.
2. Existing concrete over the trench shall be sawcut to a full depth in straight lines, at a minimum distance of 12 inches beyond the edge of the trench, either parallel to the curb or a right angles to the alignment of the sidewalk.
3. Boards or other suitable material shall be placed under equipment outrigging to prevent damage to paved surfaces.

C. Trench Width:
1. The maximum allowable trench widths at the top of the all pipe materials outside diameter of barrel pipe plus 18 inches. shall be as follows:
   a. The maximum trench width shall be inclusive of all shoring.
   b. If the maximum trench width is exceeded, the State's representative may direct the Contractor to encase or cradle the pipe in concrete at no additional charge.
2. For pipes 3 inch diameter and larger, the free working space on each side of the pipe barrel shall not be less than 6 inches.

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 Engineer.
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 Engineer.
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 Engineer.

E. Open Trench:
1. The maximum length of open trench shall be 300 feet or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is greater. No trench shall be left open at the end of the day.
2. Provisions for trench crossings and free access shall be made at all street crossings, driveways, water gate valves, and fire hydrants.
3. 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.

4. Excavation Depth for Bedding: Minimum of 6 inches below bottom of pipe or as otherwise allowed or required by the Geotechnical Engineer, except that bedding is not required for nominal pipe diameters of 2 inches or less.
5. Over-Excavations: Backfill trenches that have been excavated below bedding design subgrade, with approved bedding material.
6. Where forming is required, excavate only as much material as necessary to permit placing and removal of forms.
7. 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.

F. Excavated Material:
1. All excavated material not required for backfill shall be immediately removed and properly disposed of in a legal manner by the Contractor.
2. Material excavated in streets and roadways shall be laid alongside the trench no closer than 2 feet from the trench edge and kept trimmed to minimize inconvenience to public traffic.
3. Provisions shall be made whereby all storm and wastewater can flow uninterrupted in gutters or drainage channels.

3.5 CONTROL OF WATER AND DEWATERING

A. Contractor attention is directed to Section 31 23 19, Dewatering.

B. 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 Engineer and the Owner until backfilling is completed.

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

D. Obtain the Geotechnical Engineer’s approval for proposed control of water and dewatering methods.

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

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

3.6 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, submit details and calculations to the Owner. The Owner may forward the submittal to the Geotechnical Engineer, 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.

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.

3.7 PIPE BEDDING

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

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 Engineer. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Engineer. Jetting or ponding of bedding material will not be permitted.

C. Stabilization of Trench Bottom: When the trench bottom is unstable due to wet or spongy foundation, trench bottom shall be stabilized with gravel or crushed rock. The State's inspector will determine the suitability of the trench bottom and the amount of gravel or crushed rock needed to stabilize a soft foundation. Soft material shall be removed and replaced with gravel or crushed rock as necessary.

D. Placement of Bedding Material: The trench bottom shall be cleaned to remove all loose native material prior to placing select backfill material. Sufficient select backfill material shall be placed in trench and tamped to bring trench bottom up to grade of the bottom of pipe. The relative compaction of tamped material shall be not less than 90 percent. It is the intention of these requirements to provide uniform bearing under the full length of pipe to a minimum width of 60 percent of the external diameter.

3.8 BACKFILLING

A. Initial Backfill:
   1. Obtain approval of backfill material from Geotechnical Engineer.
   2. 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 bedding material at optimum water content to 90% relative compaction unless specified otherwise on the Plans or by the Geotechnical Engineer. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Engineer. Jetting or ponding of initial backfill material will not be permitted.

B. Pipe Detection: In trenches containing pressurized plastic pipes, tracer wire shall be placed directly above the pipe and shall be connected to all valves, existing exposed tracer wires, and other appurtenances as appropriate.

C. Subsequent Backfill:

1. Above the level of initial backfill, the trench shall be backfilled with non-expansive native material from trench excavation or with imported select backfill material (Contractor's option). Subsequent backfill shall be free of vegetable matter, stones or lumps exceeding 3 inches in greatest dimension, and other unsatisfactory material.
2. 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 bedding material at 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 Engineer. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Engineer. 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 that may cause excessive pipe displacement or damage the pipe. Jetting of trench backfill is not permitted.

E. Utility backfill shall be inspected and tested by the Geotechnical Engineer during placement. Cooperate with the Geotechnical Engineer 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 Engineer and the Owner prior to proceeding with the Project.

F. Compaction testing shall be in accordance with California Test Method ASTM D1556 or D1557.

3.9 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.

END OF SECTION

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SECTION 32 05 13-10

SOIL FOR BIORETENSION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soil for bioretention facilities.

1.2 SECTION EXCLUDES

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

B. Trenching and backfill for utilities such as underground water, sewer, storm drainage, electric, telephone, gas, cable TV, etc.

C. Import fill.

D. Structural fill.

1.3 RELATED SECTIONS

A. Section 02300, Earthwork.

B. Section 02310, Utility Trenching and Backfill

C. Section 02630, Storm Drainage System.

D. Section 02620, Subdrainage.

1.4 RELATED DOCUMENTS

A. Geotechnical Report: See Section 02000

B. ASTM:
1. C 33, Specification for Concrete Aggregates.
2. D 422, Standard Test Method for Particle Size Analysis of Soils
3. D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
4. D2434, Constant head permability.
5. D 2487, Classification of Soils for Engineering Purposes.
6. D 3740, Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
7. D 4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
8. E 329, Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
9. E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.

C. California Building Code, California Code of Regulations, Title 24, Part 2 - Chapter 33, Site Work, Demolition and Construction.

D. Caltrans Standard Specification Section
   1. Section 19, Earthwork.

E. US Composting Council, Testing Methods for the Examination of Compost and Composting (TMECC)
   1. (TMECC) 05.07A, “Loss-On-Ignition Organic Matter Method”.

F. US EPA, 40 CFR 503 Regulations.

G. CAL/OSHA, Title 8.

1.5 DEFINITIONS

A. ASTM: American Society for Testing and Materials.

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

C. C:N Ratio: Carbon to Nitrogen Ratio.

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

E. USCS: United States Composting Council.

F. STA: Seal of Testing Assurance.

G. TMECC: Testing Methods for the Examination of Compost and Composting.

H. 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.

I. Subsequent Backfill: Material from 12-inches above top of pipe to subgrade of surface material or subgrade of surface facility or to finish grade.

J. 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.

K. Utility Structures:
   1. Storm drainage manholes, catch basins, drop inlets, curb inlets, cleanouts, vaults, etc.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 02000.

B. Product Data:

1. Grading and quality characteristics showing compliance with requirements for the Work.
2. Certification from the soil supplier or an accredited laboratory that material meets requirements of the Project.

C. Samples:
1. If required by the Geotechnical Consultant and/or Landscape Architect, provide 40-pound samples of mixed bioretention soil 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 and/or Landscape Architect.
2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Consultant, Landscape Architect and the Owner's Representative's.

D. Material Test Reports: Provide, from a qualified testing agency, the following test results showing compliance with the project requirements:
1. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
2. Quality analysis results for compost performed in accordance with TMECC (Seal of Testing Assurance (STA) standards).
3. Organic content test results of mixed Bioretention Soil in accordance with Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".
4. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
5. Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site.
6. Laboratory compaction curve in conformance with ASTM D 1557 for each imported backfill material.

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 Landscape Architect and meet the approval of the Geotechnical Consultant and Landscape Architect.

C. Conform all work to the appropriate portion(s) of the Caltrans Standard Specifications, Section 19.

D. Material for bioretention facilities must be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility and must provide sufficient retention of moisture and nutrients to support healthy vegetation.

E. Material for bioretention facilities shall be free of inert materials and other deleterious substances.

F. 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.

G. The Geotechnical Consultant will perform observations and tests required to enable him to form an opinion of the acceptability of the placement of the bioretention soil mix. Correct the bioretention soil mix 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 excavations with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.

C. Temporarily stockpile Bioretention Soil Mix material in an orderly and safe manner and in a location approved by the Owner's Representative.

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

PART 2 PRODUCTS

2.1 BIORETENTION SOIL MIX

A. General Requirements:
1. The bioretention soil mix shall have a long term infiltration rate of 5inches to 12 inches per hour.
2. The bioretention soil mix shall consist of a mixture of fine sand and compost measured on a volume basis:

a. 60%-70% Sand
b. 30%-40% Compost

B. Sand: Conform to ASTM C33 for fine aggregate.
1. Clean and free of clay, silt, dust, organic material or any deleterious substances.
2. All aggregate passing the No. 200 sieve shall be non-plastic (plasticity index < 12, per ASTM D 4318).
3. Shall meet the following gradation (ASTM D 422):

Sieve Size	**Percent Passing (by weight)**	
	Min	**Max**
3/8"	**100**	**100**
No. 4	**90**	**100**
No. 8	**70**	**100**
No. 16	**40**	**95**
No. 30	**15**	**70**
No. 40	**5**	**55**
No. 100	**0**	**15**
No. 200	**0**	**5**

C. Compost Material: Shall be a well decomposed, stable, weed free, organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council. The product shall be certified through the USCC Seal of Testing Assurance Program.

1. Feedstock Materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
2. Organic Matter Content: 35% - 75% by dry weight
3. Carbon and Nitrogen Ratio: C:N < 25:1 and C:N > 15:1.
4. Maturity/Stability: Shall have a dark brown color and a soil like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or with a temperature at or above 120° F upon delivery or rewetting is not acceptable. In addition any one of the following is required to indicate stability:
   a. Oxygen Test < 1.3 O2 / unit TS / hr
   b. Specific oxy. Test < 1.5 O2 / unit BVS
   c. Respiration test < 8 C / unit VS / day
   d. Dewar test < 20 Temp. rise (C)
   e. Solvita® > 5 Index value
5. Toxicity: Any one of the following measures is sufficient to indicate non-toxicity.
   a. NH4- : NO3-N < 3
   b. Ammonium < 500 ppm, dry basis
   c. Seed Germination > 80% of control
   d. Plant Trials > 80% of control
   e. Solvita® > 5 Index value
6. Nutrient Content: Provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S and B.
   a. Total Nitrogen content 0.9% or above preferred.
   b. Boron: Total shall be < 80 ppm; Soluble shall be < 2.5 ppm
7. Salinity: Must be reported; < 6.0 mmhos/cm
8. pH shall be between 6.5 and 8. [may vary with plant species]
9. Shall meet the following gradation (ASTM D 422):

Sieve Size	**Percent Passing (by weight)**	
	Min	**Max**
1”	**99**	**100**
½”	**90**	**100**
¼”	**40**	**90**
No. 200	**1**	**10**

10. Bulk density: Between 500 and 1100 dry lbs/cubic yard.
11. Moisture Content: Between 30% - 55% of dry solids.
12. Inerts: Shall be free of inert material, including glass, plastic, paper and other deleterious substances (< 1.0% by weight or volume).
13. Weed seed pathogen destruction: Provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C ofr 15 days with at least 5 turnings during that period.
14. Select pathogens: Salmonella < 3 MPN/4grams of TS, and Coliform Bacteria < 10000 MPN/gram.
15. Trace Contaminant Metals (Lead, Mercury, etc.): Product must meet US EPA, 40 CFR 503 Regulations.

PART 3 EXECUTION

3.1 TRENCHING AND EXCAVATION

A. Excavate bioretention areas to the limits shown on plan.

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.

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/excavations 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/excavation that is opened or partially opened at any one time. Do not leave trenches/excavations 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/excavation will be subject to testing by Geotechnical Consultant. Correct deficiencies as directed by the Geotechnical Consultant.

I. Avoid over-compaction of native soils in the area of the excavation. Delineate the bioretention facility area and keep construction traffic off. Protect soils as necessary with fencing, plywood, etc.

J. Provide erosion control in the contributing drainage area and stabilize slopes and or walls of excavation. Excavations for bioretention facilities shall be kept free of sediment from eroded soils.

K. Grade bottom of trench/excavations 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.

L. Prepare the bottom of excavations to promote infiltration from bioretention soil mix to native soils (scarify upper 3").

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

F. Dispose of collected groundwater in a lawful manner.

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 BACKFILLING

A. Obtain approval of bioretention soil mix from Geotechnical Consultant and/or Landscape Architect.

B. If mixing bioretention soil mix onsite, use an adjacent impervious area or on plastic sheeting.

C. Do not place or work bioretention soil if it is raining or the mix is saturated or raining.

D. Bring rock backfill up simultaneously on both sides of the subdrain section, so as to prevent any displacement of the pipe from its true alignment. Carefully place and compact rock backfill material to an elevation of 12-inches above the top of the pipe in layers not exceeding 8-inches in loose thickness. Compact rock backfill material by vibratory equipment unless specified otherwise on the Plans or by the Geotechnical Consultant. Jetting or ponding of initial backfill material will not be permitted.

E. Bring bioretention soil mix 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 at optimum water content to 85% relative compaction by book pack (walk around to firm) or wetting, unless specified otherwise on the Plans or by the Geotechnical Consultant. Jetting or ponding of subsequent backfill material will not be permitted.

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

G. Bioretention soil mix backfill shall be inspected and tested by the Geotechnical Consultant and Landscape Architect during placement. Cooperate with the Geotechnical Consultant and Landscape Architect 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, the Landscape Architect and the Owner's Representative prior to proceeding with the Project.

3.5 CLEANUP

A. Upon completion of bioretention facilities work 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.

B. See Section 02000 for further cleanup requirements.

END OF SECTION

SECTION 32 11 00

PAVEMENT BASE COURSE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Aggregate subbase

B. Aggregate base

C. Cement treated base

D. Lime stabilization

1.2 RELATED SECTIONS

A. Section 01 10 00, Supplemental General Requirements

B. Section 01 50 50, Erosion Control

C. Section 31 20 00, Earth Moving

1.3 RELATED DOCUMENTS

A. Geotechnical Report ***[Insert Report Title, Company, and Report Date]***

B. ASTM:
1. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
2. D3740, Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
3. E329, Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
4. E548, Guide for General Criteria Used for Evaluating Laboratory Competence

C. Caltrans Standard Specifications, 2015
1. Section 24, Stabilized Soils
2. Section 25, Aggregate Subbases
3. Section 26, Aggregate Bases
4. Section 27, Cement Treated Bases

1.4 DEFINITIONS

A. Geotechnical Testing Agency: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock definition testing, as documented according to ASTM D3740 and ASTM E548.

B. 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 D1586, exceeds a standard penetration resistance of 100 blows/2 inches.

C. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below grade.

D. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, base or topsoil materials. Perform work in accordance with Section 31 20 00, Earth Moving.

1.5 SUBMITTALS

A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.

B. Submit material certificates signed by the material producer and the Contractor, certifying that that each material item complies with, or exceeds the specified requirements.

1.6 QUALITY ASSURANCE

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

B. 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 D1557.

C. Perform installation of base materials under the observation of the Geotechnical Engineer. Materials placed without approval of the Geotechnical Engineer will be presumed to be defective and, at the discretion of the Geotechnical Engineer, shall be removed and replaced at no cost to the Owner. Notify the Geotechnical Engineer at least 24 hours prior to commencement of base material installation and at least 48 hours prior to testing.

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

E. Finish surface of material to be stabilized prior to lime treatment shall be in accordance with Caltrans Standard Specification Section 24, Stabilized Soils.

F. Finish surface of the stabilized material after lime treatment shall be in accordance with Caltrans Standard Specifications Section 24, Stabilized Soils.

G. Finish surface of cement treated base shall be in accordance with Caltrans Standard Specification Section 27, Cement Treated Bases.

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

I. Finish grade tolerance at completion of base installation: +0.05 feet

1.7 PROJECT CONDITIONS

A. Protect open excavations, trenches, and the like with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.

B. Temporarily stockpile material in an orderly and safe manner and in a location approved by the Owner.

C. Provide dust and noise control in accordance with Section 01 10 00, Supplemental General Requirements.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE

A. Material: Class 2, 1 ½ inch maximum maximum in accordance with Caltrans Standard Specification Section 26, Aggregate Bases.

2.2 LIME STABILIZED SOILS

A. Material: In accordance with Caltrans Standard Specification Section 24-2, Lime Stabilized Soil.

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 WET WEATHER CONDITIONS

A. Do not place or compact subgrade if above optimum moisture content.

B. If the Geotechnical Engineer allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the Geotechnical Engineer.

3.3 AGGREGATE BASE

A. Watering, Spreading and Compacting: In accordance with Caltrans Standard Specification Section 26-1.03D, Spreading and 26-1.03E, Compacting.

3.4 LIME STABILIZATION

A. Lime stabilization shall conform to Caltrans Standard Specification Section 24, Stabilized Soils, and the following:
   1. Add lime in the amount specified by the Geotechnical Engineer.
   2. Lime treat subgrade soils from back of curb to back of curb to a depth specified by the Geotechnical Engineer.
   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 Engineer. 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 Caltrans Standard Specifications, Section 24.
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 Engineer.

3.5 DISPOSAL

A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Owner.

END OF SECTION

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SECTION 32 11 00 - SUBGRADE PREPARATION & BASE MATERIAL

PART 1 GENERAL

1.01 DESCRIPTION

A. For items shown on the Landscape Drawings that require subgrade preparation and the base material, provide subgrade preparation and the base material installation complete, including clearing, grading, excavation, and filling and dewatering.

1.02 QUALITY ASSURANCE

A. Reference Standards
1. Perform all work in accordance with all applicable laws, codes and regulations required by the City of Alameda.
2. Perform work in accordance to applicable sections of the Standard Specifications.
3. Reference to "Standard Specifications" shall mean the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.

B. Related work specified elsewhere includes:

1. Section 31 10 00, Site Preparation

2. Section 31 20 00, Earthwork

3. Section 32 12 19, Sports Court Pavement

4. Section 32 13 13, Landscape Concrete

5. Section 32 15 40, Decomposed Granite Paving

6. Section 32 85 00, Landscape Drainage

C. Stipulations

1. The finished surface of the subgrade, at any point, shall not vary more than 0.05' above or below the elevation indicated on the drawings.

D. ASTM Standards.

1. Relative Compaction: Relative compaction as determined by the ASTM D1557 test procedure, latest edition.

1.03 SUBMITTALS

A. Provisions: Comply with the General Conditions.

B. Material list and product data of all items proposed to be provided under this Section.

C. Certificates (certified analysis of certificate of compliance) signed by the material producer.

1.04 SOILS REPORT

A. A soil investigation report has been prepared for the project.

B. The report is available in the office of the Architect and the Construction Manager for inspection by the Contractor. Unless otherwise specified, it is intended that all work be performed in accordance with the provisions of the report.

C. Drilled piers may encounter ground water. Excavations for drilled piers may require casings and installation of concrete by means of pumping under the direction of the Geotechnical Engineer.

1.05 SOILS BORINGS

A. Subsurface soils investigations have been made at the site and logs of the test holes are available with the Soils Report. Such investigations have been made for the purposes of design only neither the Landscape Architect, Owner, nor the Soils Engineers guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations.

PART 2 MATERIALS

2.01 AGGREGATE BASE - CLASS 2

A. Aggregate base shall be Class 2, and free from vegetable matter or other deleterious substances. The percentage composition by weight of aggregate base shall conform to Section 26 of the Standard Specifications.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Verify that subgrade is free or organic matter and meets the requirements of the referenced geotechnical report.

B. Subgrade is that area on which pavement, surfacing, base, sub-base or layer of any other material which may be specified is to be placed.

C. Scarify subgrade to a depth of at least 6" below the final subgrade elevation, harrow, dry roll and break clods to achieve a finely divided condition. Remove all boulders, hardened material or rock encountered. The earth shall be uniform for the full depth and width of the subgrade.

D. Water the loose earth in a uniform manner and quantity so that the penetration will be at least 4".

E. Harrow the earth to mix the wet earth with the dry beneath, until the whole mass of loose material is at the proper state of moisture for compaction.

F. The finished subgrade, immediately prior to placing subsequent material thereon, shall be in accordance with the Standard Specifications for Class 2 Aggregate Base and the requirements of the referenced geotechnical report.

G. Within areas proposed to receive pavements or concrete slabs, the upper 6 inches of native soil should be uniformly moisture conditioned to at least optimum moisture content and compacted between 90 to 95 percent of maximum dry density as determined by ASTM Test Method D1557.

H. Fill material placed more than 12 inches below the final pad subgrade should be placed in 8” thick lifts and uniformly moisture conditioned to near optimum moisture content and compacted between 90 to 95 percent relative compaction.

I. Prior to final construction of paving, the subgrade should be proof rolled to provide a smooth, firm non yielding surface.

3.02 AGGREGATE BASE

A. Deliver to site as a uniform mixture and spread each layer in one operation without segregation.

B. Class 2 Aggregate Base shall be readily compacted and spread with equipment that will provide a uniform layer conforming to the planned section, and as specified in Section 26 of the Standard Specifications Base and the requirements of the referenced geotechnical report.

C. Compact Aggregate Base to a minimum of 95 percent of maximum dry density as determined by ASTM Test Method D1557.

D. Prior to final construction of paving, the aggregate base should be proof rolled to provide a smooth, firm non yielding surface.

E. Unsatisfactory material shall be removed and repaired to the satisfaction of the Geotechnical Engineer.

3.03 CLEANUP per Section 01 7000.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hot Mix Asphalt

B. Tack coat

C. Hot Mix Asphalt paving

D. Hot Mix Asphalt overlay

E. Speed bumps

F. Asphalt curbs

G. Pavement grinding

H. Adjusting manholes, valves, monument covers and other structures to grade

1.2 RELATED SECTIONS

A. Section 01 10 00, Supplemental General Requirements

B. Section 31 20 00, Earth Moving

C. Section 32 11 00, Pavement Base Course

1.3 RELATED DOCUMENTS

A. ***[Reference Geotechnical Report for project]*** Geotechnical Report: ***[Name, Title, Date]***

B. ASTM
1. D979: Standard Practice for Sampling Bituminous Paving Mixtures
2. D1188: Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
3. D2041: Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
4. D2726: Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
5. D2950: Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
6. D3549: Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

C. Caltrans Standard Specifications, 2015
1. Section 20: Landscape

2. Section 39: Asphalt Concrete
3. Section 88: Engineering Fabrics
4. Section 92: Asphalt Binder
5. Section 94: Asphaltic Emulsions
6. Section 96: Geosynthetics

1.4 DEFINITIONS

A. ASTM: American Society for Testing Materials.

B. Caltrans: State of California, Department of Transportation

1.5 QUALITY ASSURANCE

[Confirm Article A and B with project requirements]

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 hot mix asphalt: In-place compacted thickness of asphalt courses will be determined according to ASTM D3549.

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 D979.
   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 D2041, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement may be determined by testing core samples according to ASTM D1188 or ASTM D2726.
      a. One core sample may be taken for every 1000 square yard 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 D2950 and correlated with ASTM D1188 or ASTM D2726.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.

B. Job-Mix Designs: Certificates signed by manufacturers certifying that each hot mix asphalt mix complies with requirements.

C. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:
   1. Tack Coat: Minimum surface temperature of 60 F at application.
   2. Asphalt Base Course: Minimum surface temperature of 40 F and rising at application.
   3. Asphalt Surface Course: Minimum surface temperature of 60 F at application.
   4. Reinforcing Fabric: Air temperature is 50 F and rising and pavement temperature is 40 F and rising.

PART 2 - PRODUCTS

2.1 HOT MIX ASPHALT

A. Type A In accordance with Caltrans Standard Specifications Section 39-2, Hot Mix Asphalt.

B. Hot Mix Asphalt Materials:
   1. Asphalt Binder: Grade PG 64-10 in accordance with Caltrans Standard Specification Section 92, Asphalt Binders.
   2. Tack Coat: Grade SS1 in accordance with Caltrans Standard Specification Section 94, Asphaltic Emulsions.

C. Aggregates: 1 inch max gradation for virgin aggregate and recycled asphalt pavement (RAP) in accordance with to Caltrans Standard Specification Section 39-2.02, Type A Hot Mix Asphalt.
   1. Single lift for road surfaces: 1” Max
   2. Single lift for parking lots: ¾” Max
   3. Base Course for multiple lift sections: 1” Max
   4. Wearing Course for multiple lift sections:
      a. Road surfaces: 1” Max
      b. Parking Lots: ¾” Max
      c. Play Yards: ½” Max

D. Geosynthetic Pavement Interlayer:
   1. For HMA: Paving Fabric in accordance with Caltrans Standard Specification Section 96, Geosynthetics.
   2. For *RHMA a pavement mat shall be used*.

E. Soil Sterilant: In accordance with Caltrans Standard Specifications Section 20-5.03, Inert Ground Covers and Mulches.

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. If necessary, perform subgrade preparation or remediation in accordance with Section 31 20 00, Earth Moving.

D. Notify Owner 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 and as required to provide smooth transitions to existing paving surfaces. Maintain drainage patterns at conform locations.

3.3 SOIL STERILANT

A. Furnish and apply to areas per manufacturer's specifications.

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 in accordance with Caltrans Standard Specification Section 39-2.01C(3)(b) and in accordance with Section 32 11 00, Pavement Base Course.

B. Tack Coat: Apply uniformly and at specified rates between HMA layers, to vertical surfaces of curbs, gutters and construction joints, and to existing pavement, including planed surfaces, in accordance with Caltrans Standard Specification Section 39-2.01C(3)(f).
   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 HOT MIX ASPHALT OVERLAYS

A. Pavement Irregularities: Level with hot mix asphalt, Type A, ½ inch max aggregate.

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.

D. Overlays shall provide a smooth transition at existing pavement edge conditions. Grind existing asphalt as required to provide smooth transitions.

3.6 GEOSYNTHETIC PAVEMENT INTERLAYER

A. Place geosynthetic pavement interlayer in accordance with Caltrans Standard Specification Section 39-2.01C(3)g.

3.7 HOT MIX ASPHALT SPREADING AND COMPACTING EQUIPMENT

A. Provide spreading and compacting equipment in accordance with Caltrans Standard Specification Section 39-2.01C(2).

3.8 HOT MIX ASPHALT PLACEMENT

A. Place, spread and compact hot mix asphalt to required grade, cross section, and thickness in accordance with Caltrans Standard Specification Sections 39-2.01C(2), 39-2.01C(3), 39-2.01C(5), and 39-2.01C(8).

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.

C. Construct edge treatments to provide a smooth transition at conforms to existing pavements or shape and compact at free edges.

3.9 JOINTS

A. Construct joints to ensure continuous bond between adjoining paving sections in accordance with Caltrans Standard Specification Sections 39-2.01C(4)
   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 hot mix asphalt 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 in accordance with Caltrans Standard Specification Sections 39-2.01C(2).

B. Compaction Requirements: Average Density to be 92 percent of reference maximum theoretical density according to ASTM D2041, 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 HOT MIX ASPHALT CURBS AND DIKES

A. Construction: Place over compacted surfaces in accordance with Caltrans Standard Specification Section 39-2.01C(9). Apply a light tack coat prior to construction, unless pavement surface is still tacky and free of dust.

B. Shape: Place hot mix asphalt to curb cross section indicated.

3.12 SPEED BUMPS

A. Construct speed bumps over compacted pavement surfaces in accordance with Caltrans Standard Specification Section 39-2. Apply a light tack coat prior to construction, unless pavement surface is still tacky and free of dust.

B. Place asphalt concrete by hand using a template/screed designed to result in speed bump cross-section indicated after compaction.

C. Compact speed bumps 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: Bottom of existing asphalt pavement.
   3. Apply tack coat to all exposed surfaces.
   4. Fill excavation with hot mix asphalt and, while still hot, compact flush with adjacent surface.

3.14 INSTALLATION TOLERANCES

A. Hot Mix Asphalt Pavement:
   1. Course thickness and surface smoothness shall be in accordance with Caltrans Standard Specification Section 39-2.01A(4)(i)(iii)
   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

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SECTION 32 13 13

CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnishing, placing, spreading, compacting and shaping portland cement concrete pavement with undoweled transverse weakened plane joints, for vehicular traffic.

B. Form construction and use in placing portland cement concrete pavement.

C. Joints for portland cement concrete pavement.

D. Finishing portland cement concrete pavement.

E. Curing and protecting portland cement concrete pavement.

1.2 RELATED SECTIONS

A. 01 10 00, Supplemental General Requirements

B. 31 20 00, Earth Moving

C. 32 11 00, Pavement Base Course

D. 32 13 18, Cement and Concrete for Exterior Improvements

1.3 RELATED DOCUMENTS

A. Geotechnical Report: ***[Reference Geotechnical Report if relevant for project] [Name, Title, Date]***.

B. AASHTO Standard Specifications
   1. T132: Standard Method of Test for Tensile Strength of Hydraulic Cement Mortars

C. ASTM Standards
   1. D36: Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
   2. A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   3. A706: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
   4. A775: Standard Specification for Epoxy Coated Steel Reinforcing Bars.
   5. A934: Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
   6. A996: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
   7. C94: Standard Specification for Ready-Mixed Concrete

8. C603: Standard Test Method for Extrusion Rate and Application Life of Elastomeric Sealants
9. C639: Standard Test Method for Rheological (Flow) Properties of Elastomeric Sealants
10. C661: Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
11. C679: ASTM C679-15 Standard Test Method for Tack-Free Time of Elastomeric Sealants
12. C719: Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
13. C793: Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants
14. C881: Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
15. D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
16. D1640: Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
17. D2628: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
18. D2835: Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements.
19. D3963: Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
20. D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

D. Caltrans Standard Specifications, 2015
1. Section 10, General
2. Section 40, Concrete Pavement
3. Section 52, Reinforcement
4. Section 95, Epoxy

E. Caltrans Standard Plans:
1. Plan P1: Jointed Plan Concrete Pavement – New Construction
2. Plan P10: Concrete Pavement Dowel Bar Details

1.4 DEFINITIONS

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

B. ASTM: American Society for Testing and Materials

C. Caltrans: State of California, Department of Transportation

1.5 QUALITY ASSURANCE

[Confirm Article A and B with project requirements]

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. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.

D. Installer Qualification: An experienced installer who has completed pavement work similar in material, design and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.

B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results or other circumstances warrant adjustments.

C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements.
1. Cementitious materials and aggregates
2. Steel reinforcement and reinforcement accessories
3. Admixtures
4. Curing compound
5. Applied finish material
6. Bonding agent of adhesive
7. Joint filler
8. Joint Sealant
9. Tie Bars
10. Epoxy
11. Backer Rods

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

A. In accordance with Section 32 13 18, Cement and Concrete for Exterior Improvements.

2.2 BASE MATERIAL

A. In accordance with Section 32 11 00, Pavement Base Course.

2.3 TIE BARS

A. Deformed reinforcing steel bars conforming to the requirements of ASTM Designation A615, Grade 40 or 60

B. Epoxy-coat in accordance with Caltrans Standard Specification Section 52-2.02, Epoxy-Coated Reinforcement, except bars must comply with ASTM A706; ASTM A996; or ASTM A615, Grade 40 or 60.

C. Do not bend tie bars.

2.4 EPOXY

A. Bond tie bars to existing concrete with epoxy resin in accordance with Caltrans Standard Specification Section 95-1.02D, Epoxy Adhesive for Bonding Freshly Mixed Concrete to Hardened Concrete.

[Coordinate with Landscape plans and specs.]

2.5 SILICONE JOINT SEALANT

A. Furnish low modulus silicone joint sealant in a one-part silicone formulation. Do not use acid cure sealants. Compound to be compatible with the surface to which it is applied and conform to the following requirements:

Specification	Test Method	Requirement
Tensile stress, 150% elongation, 7-day cure at 77°± 1°F and 45% to 55% Relative Humidity	ASTM D412 (Die C)	45 psi max.
Flow at 77° ± 1°F	ASTM C639[a]	Shall not flow from channel
Extrusion Rate at 77° ± 1°F	ASTM C603[b]	75-250 g per min.
Specific Gravity	ASTM D792 Method A	1.01 to 1.51
Durometer Hardness, at 0°F, Shore A, cured 7 days at 77° ± 1°F	ASTM C661	10 to 25
Ozone and Ultraviolet Resistance, after 5000 hours	ASTM C793	No chalking, cracking or bond loss
Tack free at 77° ± 1°F and 45% to 55% Relative Humidity	ASTM C679	Less than 75 minutes
Elongation, 7 day cure at 77° ± 1°F and 45% to 55% Relative Humidity	ASTM D412 (Die C)	500 percent min.
Set to Touch, at 77° ± 1°F and 45% to 55% Relative Humidity	ASTM D1640	Less than 75 minutes
Shelf Life, from date of shipment	—	6 months min.
Bond, to concrete mortar-concrete briquets, air cured 7 days at 77° ± 1°F	AASHTO T132[c]	50 psi min.
Movement Capability and Adhesion, 100% extension at 0°F after air cured 7 days at 77° ± 1°F, and followed by 7 days in water at 77° ± 1°F	ASTM C719[d]	No adhesive or cohesive failure after 5 cycles

Notes:

a. ASTM Designation: C639 Modified (15 percent slope channel A).
b. ASTM Designation: C603, through $^{1}/_{8}$ inches opening at 50 psi.
c. Mold briquets in conformance with the requirements in AASHTO Designation: T132, sawed in half and bonded with a $^{1}/_{16}$ inches maximum thickness of sealant and tested in conformance with the requirements in AASHTO Designation: T132. Briquets shall be dried to constant mass at 212 ± 10°F.
d. Movement Capability and Adhesion: Prepare 12 inch x 1 inch x 3 inch concrete blocks in conformance with the requirements in ASTM Designation: C719. A sawed face shall be used for bond surface. Seal 2 inch of block leaving ½ inches on each end of specimen unsealed. The depth of sealant shall be $^{3}/_{8}$ inches and the width ½ inches.

B. Formulate the silicon joint sealant to cure rapidly enough to prevent flow after application on grades of up to 15 percent.

C. Furnish to the Owner's Representative a Certificate of Compliance. Accompany certificate with a certified test report of the results of the required tests performed on the sealant material within the previous 12 months prior to proposed use. Provide the certificate and accompanying test report for each lot of silicone joint sealant prior to use on the project.

2.6 ASPHALT RUBBER JOINT SEALANT

A. Conform to the requirements of ASTM Designation: D6690 as modified herein or to the following:

1. Provide a mixture of paving asphalt and ground rubber. Ground rubber to be vulcanized or a combination of vulcanized and de-vulcanized materials ground so that 100 percent will pass a No. 08 sieve and contain not less than 22 percent ground rubber, by mass. Modifiers may be used to facilitate blending.

2. The Ring and Ball softening point shall be 135°F minimum, when tested in conformance with the requirements in ASTM D36.
3. Provide asphalt rubber sealant material capable of being melted and applied to cracks and joints at temperatures below 400°F.

B. The penetration requirements of Section 4.2 of ASTM Designation: D6690 do not apply. The required penetration at 77˚F, 5 oz, 5s, shall not exceed 120.

C. The resilience requirements of Section 4.5 of ASTM Designation: D6690 do not apply. The required resilience, when tested at 77°F, shall have a minimum of 50 percent recovery.

D. Accompany each lot of asphalt rubber joint sealant shipped to the job site, whether as specified herein or conforming to the requirements of ASTM Designation D6690, as modified herein, by a Certificate of Compliance, storage and heating instructions and precautionary instructions for use.

E. Heat and place in conformance with the manufacturer's written instructions and the details shown on the Plans. Provide manufacturer's instructions to the Owner's Representative. Do not place when the pavement surface temperature is below 50 ˚F.

2.7 PREFORMED COMPRESSION JOINT SEALANT

A. Material: ASTM Designation: D2628.
1. Number of cells: 5 or 6.
2. Lubricant Adhesive: ASTM Designation D2835.
3. Install compression seals along with lubricant adhesive according to the manufacturer's recommendations. Submit manufacturer's recommendations to the Owner's Representative`.

B. Accompany each lot of compression seal and lubricant adhesive by a Certificate of Compliance, storage instructions and precautionary instructions for use. Also submit the manufacturer's data sheet with installation instructions and recommended model or type of preformed compression seal for the joint size and depth as shown on the Plans. Show evidence that the selected seal is being compressed at level between 20 and 50 percent at all times for the joint width and depth shown on the Plans.

2.8 BACKER RODS

A. Provide backer rods that have a diameter prior to placement at least 25 percent greater than the width of the saw cut after sawing and are expanded, crosslinked, closed-cell polyethylene foam that is compatible with the joint sealant so that no bond, adverse reaction occurs between the rod and sealant. In no case use a hot pour sealant that will melt the backer rod. Submit a manufacturer's data sheet verifying that the backer rod is compatible with the sealant to be used.

2.9 SLIP RESISTIVE AGGREGATE FINISH

A. Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

PART 3 - EXECUTION

3.1 WATER SUPPLY

A. Provide water supply in accordance with Caltrans Standard Specification Section 10-6, Watering.

3.2 SUBGRADE

A. Prepare subgrade in accordance with Caltrans Standard Specification Section 40-1.03F, Placing Concrete.

3.3 SOIL STERILANT

A. Furnish and apply to areas indicated in accordance with Section 31 20 00, Earth Moving.

3.4 PLACING

A. Prepare concrete in accordance with Caltrans Standard Specification Section 40-1.03F, Placing Concrete.

3.5 SPREADING COMPACTING AND SHAPING

A. Conform to the following, at the option of the contractor:
   1. Stationary Side Form Construction: In accordance with Caltrans Standard Specification Section 40-1.03F(4), Stationary Side-Form Construction.
   2. Slip Form Construction: In accordance with Caltrans Standard Specification Section 40-1.03F(4), Slip Form Construction.

3.6 INSTALLING TIE BARS

A. Install at longitudinal contact joints, longitudinal weakened plane joints, and transverse contact joints as shown on the Plans. In no case, shall any consecutive width of new portland cement concrete pavement tied together with tie bars exceed 50 feet. In no case shall tie bars be used at a joint where portland cement concrete and asphalt concrete pavements abut.

B. Tie bars shall be installed at longitudinal joints by one of the 3 following methods:
   1. Drilling and bonding in conformance with the details shown on the Plans. Provide a two-component, epoxy-resin, conforming to the requirements of ASTM Designation: C881, Type V. Grade 3 (Non-Sagging), Class shall be as follows:

Temperature of Concrete	Required Class of Epoxy Resin
Lower than 40° F	A
40˚ F through 60˚ F	B
Above 60˚ F	C

   2. Provide, at least 7 days prior to start of work, a Certificate of compliance and a copy of the manufacturer's recommended installation procedure. The drilled holes shall be cleaned in accordance with the epoxy manufacturer's instructions and shall be dry at the time of placing the epoxy and tie bars.

Immediately after inserting the tie bars into the epoxy, the tie bars shall be supported as necessary to prevent movement during the curing and shall remain undisturbed until the epoxy has cured a minimum time as specified by the manufacturer. Tie bars that are improperly bonded, as determined by the Owner's Representative, will be rejected. If rejected, adjacent new holes shall be drilled, as directed by the Owner's Representative, and new tie bars shall be placed and securely bonded to the concrete. All work necessary to correct improperly bonded tie bars shall be performed at the Contractor's expense.

3. Insert the tie bars into the plastic slip-formed concrete before finishing the concrete. Inserted tie bars shall have full contact between the bar and the concrete. When tie bars are inserted through the pavement surface, the concrete over the tie bars shall be reworked and refinished to such an extent that there is no evidence on the surface of the completed pavement that there has been any insertion performed. Any loose tie bars shall be replaced by drilling and grouting into place with epoxy as described in method 1 above at the Contractor's expense.
4. By using threaded dowel splice couplers fabricated from deformed bar reinforcement material, free of external welding or machining. Threaded dowel splice couplers shall be accompanied by a Certificate of Compliance and installation instructions. Installation of threaded dowel splice couplers shall conform to the requirements of the manufacturer's recommendations.

3.7 JOINTS

A. Construct joints in accordance with Caltrans Standard Specification Section 40-1.03B, Joints, except that tie bars shall be as specified under Part 1, Materials.
   1. Construction Joints: In accordance with Caltrans Standard Specification Section 40-1.03B(2), Construction Joints.
      a. Construct a construction joint at the end of each day's work, or where concrete placement is interrupted for more than 30 minutes, to coincide with the next weakened plane joint location.
      b. If sufficient concrete has not been mixed to form a slab to match the next contraction joint, when an interruption occurs, the excess concrete shall be removed and disposed of back to the last preceding joint. The cost of removing and disposing of any excess concrete shall be at the Contractor's expense. Any excess material shall be become the property of the Contractor and shall be properly disposed of.
      c. A metal or wooden bulkhead (header) shall be used to form the joint. The bulkhead shall be designed to accommodate the installation of tie bars.
   2. Contraction Joints: In accordance with Caltrans Standard Specification Section 40-1.03B (3), Contraction Joints, except that the insert method of forming joints in pavement shall not be used.

3.8 FINISHING

A. Finish concrete in accordance with Caltrans Standard Specification Section 40-1.03H, Finishing.

B. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:
   1. Uniformly spread ***60 lb per 100 sq. ft.*** of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.

2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.

3.9 CURING

A. Cure concrete in accordance with Caltrans Standard Specification Section 40-1.03I, Curing.

3.10 SEALING JOINTS

A. Liquid Joint Sealant Installation.

1. The joint sealant detail for transverse and longitudinal joints, as shown on the Plans, shall apply only to weakened plane joints. Construct weakened plane joints by the sawing method. Should grinding or grooving be required over or adjacent to any joint after sealant has been placed, completely remove the joint material and disposed of, and replace at the Contractor's expense. Recess sealant below the final finished surface as shown on the Plans.
2. At the Contractor's option, transverse weakened plane joints shall be either Type DSC or Type SSC as shown on the Plans. Longitudinal weakened plane joints shall be Type SSC only as shown on the Plans.
3. Seven days after the concrete pavement placement and not more than 4 hours before placing backer rods and joint sealant materials, clean the joint walls by the dry sand blast method and other means as necessary to completely remove from the joint all objectionable material such as soil, asphalt, curing compound, paint and rust. After cleaning the joint, remove all traces of sand, dust and loose material from and near the joint for a distance along the pavement surfaces of at least 2 inch on each side of the joint by the use of a vacuum device. Remove surface moisture at the joints by means of compressed air or moderate hot compressed air or other means approved means. Do not use drying procedures that leave a residue or film on the joint wall. Sandblasting equipment shall have a maximum nozzle diameter size of 1/4 $\pm$ 1/32 inches and a minimum pressure of 90-psi.
4. Install backer rod as shown on the Plans. Provide an expanded, closed-cell polyethylene foam backer rod that is compatible with the joint sealant so that no bond or adverse reaction occurs between the rod and sealant. Install backer rod when the temperature of the portland cement concrete pavement is above the dew point of the air and when the air temperature is 40°F or above. Install backer rod when the joints to be sealed have been properly patched, cleaned and dried. Do not use a method of placing backer rod that leave a residue or film on the joint walls.
5. Immediately after placement of the backer rod, place the joint sealant in the clean, dry, prepared joints as shown on the Plans. Apply the joint sealant by a mechanical device with a nozzle shaped to fit inside the joint to introduce the sealant from inside the joint. Apply adequate pressure to the sealant to ensure that the sealant material is extruded evenly and that full continuous contact is made with the joint walls. After application of the sealant recess the surface of the sealant as shown on the Plans.
6. Any failure of the joint material in either adhesion or cohesion of the material will be cause for rejection of the joint. Conform the finished surface of joint sealant to the dimensions and allowable tolerances shown on the Plans.

Rejected joint materials or joint material whose finished surface does not conform to the dimensions shown on the Plans shall be repaired or replaced, at the Contractor's expense, with joint material that conforms to the requirements.

7. After each joint is sealed, remove all surplus joint sealer on the pavement surface. Traffic shall not be permitted over the sealed joints until the sealant is tack free and set sufficiently to prevent embedment of roadway debris into the sealant.

B. Preformed Compression Joint Seal Installation

1. The compression seal alternative joint detail for transverse and longitudinal joints, as shown on the Plans, shall apply only to weakened plane joints. Construct weakened plane joints by the sawing method. Should grinding or grooving be required over or adjacent to any joint after the compression seal has been placed, completely remove the joint materials and disposed of, and replace at the Contractor's expense. Compression seal shall be recessed below the final finished surface as shown on the Plans.
2. At the Contractor's option, transverse weakened plane joints shall be either Type DSC or Type SSC as shown on the Plans. Longitudinal weakened plane joints shall be Type SSC only as shown on the Plans.
3. Seven days after the concrete pavement placement and not more than 4 hours before placing preformed compression joint seals, clean the joint walls by the dry sand blast method and other means as necessary to completely remove from the joint all objectionable material such as soil, asphalt, curing compound, paint and rust. After cleaning the joint, remove all traces of sand, dust and loose material from and near the joint for a distance along the pavement surfaces of at least 50 mm on each side of the joint by the use of a vacuum device. Remove surface moisture at the joints by means of compressed air or moderate hot compressed air or other means. Do not use drying procedures that leave a residue or film on the joint wall. Sandblasting equipment shall have a maximum nozzle diameter size of 1/4 $\pm$ 1/32 inches and a minimum pressure of 90 psi.

3.11 PROTECTING CONCRETE PAVEMENT

A. Protect pavement in accordance with Caltrans Standard Specification Section 40-1.03J Protecting Concrete Pavement.

END OF SECTION

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SECTION 32 13 13 – LANDSCAPE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Provide Portland cement concrete site work complete, including the following principal items:

1. Footings for fencing, foundations, site furnishings.
2. Pavements, including aggregate bases.
3. Curbs, borders, footings for site work, pads, curbs ramps, bands, and utility collars.

B. Related Sections include:

1. Section 00 31 19, Existing Conditions
2. Section 00 31 32, Geotechnical Data
3. Section 01 11 00, Summary of Work
4. Section 01 45 00, Quality Control
5. Section 01 56 16, Dust Control
6. Section 01 56 19, Noise Control
7. Section 01 71 23, Field Engineering
8. Section 02 41 00, Site Preparation & Plant Protection
9. Section 12 93 05, Site Furnishings
10. Section 31 25 00, Erosion Control
11. Section 32 11 13, Subgrade Preparation & Base Material
12. Section 32 31 13, Chain Link Fencing
13. Section 33 40 10, Storm Drainage

1.2 SUBMITTALS

A. Section 01 – Submittals: Submittal procedures.

B. The Contractor's Testing Laboratory's certificate of compliance.

C. The Contractor shall submit:

1. Certified copies of mix designs for each concrete class specified including compressive strength test reports.

2. Certification that materials meet requirements specified.

3. Certification from vendor that samples originate from and are representative of each lot proposed for use.

4. Weight master Certificates for concrete delivered to the site and used for improvements.

5. Mill certifications for reinforcing steel.

6. Product literature and samples of truncated dome pavers.

7. Items required under Waiver of Batch Plant Inspection specified herein.

8. Items required by Form DSA-103 Testing & Inspection Sheet.

9. Shop drawings showing reinforcing steel.

D. The Owner's Testing Agency will submit reports on tests and inspections performed to the Owner, the Landscape Architect, the Contractor, and the Division of the State Architect.

E. Schedule of placing for the Construction Manager’s review before starting Work.

F. Mock-ups of all materials under this Division shall be supplied for testing as requested by the Project Inspector.

G. Provide mock up of all concrete finishes, color and joints (with curing compound if any to be used) indicated on the drawings. Accepted mock-ups shall be kept at the job site to serve as a prerequisite for all finishes.

1.3 QUALITY ASSURANCE

A. Reference and Standards:

1. Requirements of GENERAL CONDITIONS and DIVISION NO. 1 applies to all Work in this Section.

2. Perform work in accordance with all applicable laws, codes and regulations require by City of San Mateo and the State of California.

3. Reference to "Standard Specifications" shall mean the current Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.
4. The American Concrete Institute (ACI): "Manual of Concrete Practice," Parts 1, 2 and 3.

5. California Code of Regulations. Title 24, Current edition, also known as California Building Code (CBC).

6. American Society for Testing and Materials (ASTM).

B. Stipulations:

1. Finish Surface Tolerance: 1/4-inch maximum variation in 10 feet.

2. At no point shall paving surface fail to drain.

3. The finish surface of concrete paving along accessible routes of travel shall be at least as slip resistant as medium broom finish perpendicular to the path of travel for slopes under 6%, and slip resistant heavy broom finish perpendicular to the path of travel at slopes 6% or greater. See the landscape drawings for specified finishes. Ground and floor finishes shall be stable, firm and slip resistant and shall comply with CBC 11B-302.

4. Contractor to provide conformance survey showing the finished grade of concrete paving is in conformance with the designed grades.

5. The Contractor shall be responsible for quality of concrete in place color and finish and control of cracking and spalling. All exposed concrete shall have a consistent color and finish and be free from uncontrolled cracking and spalling.

6. The Contractor shall be responsible for quality of concrete in place and shall bear burden of proof that concrete meets minimum requirements. Use the same mix design for all exposed concrete.

7. Placing of concrete by means of pumping will be an acceptable method of placement providing that the Contractor can demonstrate that:

a. Specified concrete strengths will be met.

b. Equipment has a record of satisfactory performance under similar conditions and using a similar mix.

c. Trial batches have been made.

1.4 TESTS

A. The Project Inspector will select a qualified testing laboratory to take samples for testing during the course of the work as considered necessary. The Owner will pay costs for such tests. Contractor shall cooperate in making tests and shall be responsible for notifying the designated laboratory in sufficient time to allow taking of samples at time of pour.

B. Should tests show that concrete is below specified strength, Contractor shall remove all such concrete, as directed by the Project Inspector. Full cost of removal of low strength concrete, its replacement with concrete of proper specified strength and testing, shall be borne by Contractor.

C. The Contractor's Testing Laboratory Qualifications: The Contractor's Testing Laboratory shall be under direction of a Civil Engineer registered in the State of California, shall have operated successfully for four years prior to this work, and shall conform to requirements of ASTM E329.

1.5 SOILS REPORT

A. A soil investigation report has been prepared for the project.

B. The report is available in the office of the Architect and the Construction Manager for inspection by the Contractor. Unless otherwise specified, it is intended that all work be performed in accordance with the provisions of the report.

C. Drilled piers may encounter ground water. Excavations for drilled piers may require casings and installation of concrete by means of pumping under the direction of the Geotechnical Engineer.

PART 2 - PRODUCTS

2.1 FORMWORK MATERIALS

B. Forms shall be wood, except curbs may be formed with accepted metal form systems.

1. Plywood: 5/8-inch thickness minimum. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class 1. Panels to receive specified form sealer to ensure uniform finish of exposed surfaces.

2. Lumber: Douglas fir, "Standard" grade or better (grade marks not required).

B. Form Coatings: Knox-Crete, or equal.

C. Form Ties: Burke "Penta-Tie," or equal, cone and rod type with 1-inch break-back or product similar to appropriately sized Simpson Strong Tie WT, or equal. Do not use form ties in forms for concrete seat wall and sculpture table.

2.2 REINFORCING MATERIALS

A. Bar Reinforcement ASTM A615.

1. #3 and smaller: Grade 40.

2 #4 and larger: Grade 60.

C. Smooth Dowels: Aztec Concrete Accessories “Speed Dowels,” or equal product 800-531-3355.

2.3 CONCRETE CLASSES Check Geotech Report when we get it

CLASS	STRENGTH	AGGREGATE	WEIGHT	SLUMP
A	3000	3/4	145	4

A. Class: Identifies all concrete as specified.

B. Strength: Compressive strength in psi after 28-days when tested in accordance with ASTM C39. All concrete shall develop compression strength specified in 28-days. To meet above requirements, mix shall be designed such that average compressive strength will exceed specified 28-day strength by an amount as specified by ACI 318.

C. Aggregate: Maximum size in inches.

D. Weight: Pounds per cubic foot, air dry.

E. Slump: In inches when tested in accordance with ASTM C143.

2.4 CONCRETE MATERIALS

A. General Requirements:

1. Cement and aggregates shall have proven history of successful use with one another. Sources of cement and aggregate shall remain unchanged throughout work unless the Landscape Architect approves request for change made at least 10-days prior to anticipated date of casting.

2. Ready-mixed concrete shall meet requirements of ASTM C94.

3. Deviations in properties of materials tested by the Owner's Testing Agency shall be cause for their rejection pending additional test results and redesign of mix by the Contractor's Testing Laboratory.

4. No frozen aggregates will be permitted.

B. Cements:

1. ASTM C150, Type V or Type II (modified). Use one brand of cement throughout project unless otherwise acceptable to Landscape Architect.

C. Fly Ash: ASTM C618, Type F. Fly ash as a replacement for Portland cement use no less than 15% if used, and no more than 25%.

D. Aggregates:

1. Coarse: ASTM C33. Coarse aggregate shall consist of a clean, hard, fine grained, sound crushed rock, or washed gravel or a combination of both. It shall be free from oil, organic matter or other deleterious substances and shall not contain more than two percent by weight of shale or cherty material. "Cleanness value shall not be less than 75 when tested per MM Test Method, 227 and conforming to CBC.

2. Fines: ASTM C33. Sand equivalent shall be not less than 75 when tested as per ASTM D2419.

3. Provide aggregates from a single source for exposed concrete.

E. Water: Clean and potable, free from impurities detrimental to concrete.

F. Water-Reducing Admixture: Must be compatible with color pigments where required. ASTM C494, Type A, that do not contain non-lignini sulfonate. Same as Grace Construc-

tion Materials' "WRDA" with hycol; Master Builders "Pozzolith" 322N; or equal product substituted per Section 01 25 00 Substitution Options & Procedures.

G. Air Entraining Admixture: Must be compatible with color pigments where required. ASTM C260, certified by manufacturer to be compatible with other products. Same as W.R. Grace's "Daravair", Master Builders' "Micro-Air", Sika Corp.'s "Sika Aer", or equal product substituted per Section 01 25 00 Substitution Options & Procedures.

H. Other Admixtures: Only as approved by the Landscape Architect.

I. Non-Shrink Grout: Premixed high strength grout requiring only addition of water at the site. Same as Master Builder's "Masterflow 928 Grout"; Burke's "Non-Ferrous, Non-Shrink Grout", or equal product substituted per Section 01 25 00 Substitution Options & Procedures.

J. Curing Materials:

1. Curing Compound: ASTM C309. Water loss – not more than 0.55 kg/m^2 in 72 hours; Light Reflectance – not less than 60%. Same as Grace Construction Materials' "Horn Clear Seal"; Grimes Co.'s "Sealcrete"; Master Builders' "Masterseal W", or equal product substituted per Section 01 25 00 Substitution Options & Procedures.

2. Apply to slabs-on-grade at 150 percent of manufacturer's recommended coverage rate.

K. Epoxy Adhesive: Two component material suitable for anchoring rebar into dry or damp concrete. Same as Burke's "Burk Epoxy MV", Covert's "CIA-Gel 7000", Hilti's "HIT C-100" or equal product substituted per Section 01 25 00 Substitution Options & Procedures.

L. Lamp Black: As supplied by batch plant.

2.5 CONCRETE MIXES

A. Concrete mixes shall be accepted and shall be in accordance with CalTrans Standard Specifications Section 90. Unless otherwise noted, mix shall be Class "A," 3,000 psi, Type II Portland cement and 3/4-inch maximum aggregate.

B. Lamp Black: Concrete for paving shall be darkened by the addition of accepted agents at the mixer. The proportion of lampblack or other accepted colorant, to a great extent dependent on the color of the cement used in the mix, shall be that required to properly darken the concrete to reduce glare, and shall be subject to the approval of the Project Inspector or as required by Landscape Architect. Provide mock-ups with a ratio of one pound of lamp black for each cubic yard of concrete or as otherwise approved. Use Davis Colors or equal pigment as required to meet lamp black requirement.

2.6 ANCILLARY MATERIALS

A. Aggregate Base:

1. Class 2 aggregate base conforming to Section 26 of the Standard Specifications.

2. All base rock under concrete paving or curbs or concrete borders shall be virgin rock.

B. Expansion Joint Material:

1. Fiber Expansion Joint: A non-extruding resilient filler, saturated with high quality bituminous materials having preserving characteristics. W. R. Meadows or accepted equal. Conform to ASTM-D1751-83. Include Joint Sealant.

C. Concrete Sealer: Use sealer compatible with pigments in concrete. Scofield Selectseal-W as manufactured by L. M. Scofield Co. or silicone-based, non-staining product such as Consolideck® SingleStep™ acrylic-siloxane blend that meets Type I, Class A requirements of ASTM C 1315 and as accepted by Landscape Architect.

D. Joint Sealant: Use joint sealant compatible with pigments in concrete "Sonolastic Sealant Two-Part" as manufactured by Sonneborn-Contech, Building Products Division, Contech, Inc.; or Sikaflex-1a elastomeric joint sealant available from Sika Corporation, Hayward (510) 487-2294. or approved equal. Joint caps or bond breaker tape to be as recommended by sealant manufacturer. Color shall be as selected by Architect.

E. Curing Compound: ASTM C309, Water-base type, free of permanent color, oil or wax, or accepted equal. Curing compound shall be compatible with color pigments

F. Combination Curing Compound Concrete Sealer: Scofield Cureseal-W as manufactured by L. M. Scofield Co. or W. R. Meadows Vocomp-20, (800-342-5976) or accepted equal. Combination Curing Compound. Combination Curing Compound Concrete Sealer shall be compatible with color pigments.

G. Color of Concrete: Pigments for integral colored concrete as manufactured by Davis Colors, 800-356-4848, applied at manufacturer’s specified rates of application, or accepted equal.

H. Color of Concrete: Pigments for stained concrete as manufactured by L. M. Scofield, 800-800-9900, applied at manufacturer’s specified rates of application, or accepted equal.

I. Precast Truncated Dome Pavers: as shown on the Drawings and per manufactures’ specifications.

2.7 MIXES

A. General Requirements:

1. The Contractor shall perform tests or assemble the necessary data indicating conformance with specifications.

2. For each mix submit data showing that proposed mix will attain the required strength in accordance with requirements of CBC.

3. The Contractor shall instruct Laboratory to base mix design on use of materials tested and approved by the Owner's Testing Agency.

4. Mix design shall include compression strength test reports per CBC Section 1905A.3.

5. Mix shall be designed, tested, and adjusted if necessary in ample time before first concrete is scheduled to be placed. Laboratory data and strength test results for revised mix design shall be submitted to Landscape Architect prior to using in project.

6. Ensure mix designs will produce concrete to strengths specified and of uniform density without segregation.

7. If mix yield exceeds 1-cubic yard, modify mix design to no more than one cubic yard without changing cement content.
8. The Contractor's mix designs shall be subject to review by the Landscape Architect and by the Owner's Testing Agency.

9. Introduction of calcium chloride will not be permitted.

10. Unspecified admixtures will not be permitted unless the Landscape Architect reviews, the Contractor modifies mix designs as necessary, and modifications are accepted by the Owner's Testing Agency.

B. Slab-on-Grade and Concrete Paving Mix requirements:

1. Maximum water/cement ratio: 0.45.

2. Use of Water-Reducing admixture is required. Use High Range Water-Reducing admixture (super plasticizer) when required to maintain workability and pumpability.

C. Patching Mortar: Mix in proportions by volume of one part cement to two parts fine sand.

D. Concrete Fill: Mix in proportions by volume of one part cement, two parts fine aggregate, one part coarse aggregate (3/8- inch); with as little water as necessary to make stiff workable plastic mix.

E. Non-Shrink Grout: Follow approved manufacturer's printed instructions and recommendations.

2.8 MIXING

A. Batching Plant Conditions:

1. Ensure equipment and plant will afford accurate weighing, minimize segregation and will efficiently handle all materials to satisfaction of the Landscape Architect and the Owner's Testing Agency.

2. Replace at no additional expense equipment the Landscape Architect and the Owner's Testing Agency deem inadequate or unsuitable.

3. Use approved moisture meter capable of determining moisture content of sand.

B. General Requirements:

1. Thoroughly clean concrete equipment before use for Architectural concrete mixes to avoid contamination.

2. Mix cement, fine and coarse aggregates, admixtures and water to exact proportions of mix designs. Method of mixing shall comply with CBC Section 1905A.8.

3. Measure fine and coarse aggregates separately according to approved method which provides accurate control and easy checking.

4. Adjust grading to improve workability; do not add water unless otherwise directed.

5. Maintain proportions, values, or factors of approved mixes throughout work.

6. Mix concrete in transit mixers five minutes immediately prior to discharge in addition to mixing as called for by ACI 304 and ASTM C94.

C. Admixtures: Use automatic metering dispenser to introduce admixture into mix. Dispenser shall be recommended and calibrated by admixture manufacturer.

2.9 SOURCE QUALITY CONTROL

A. The Owner's Testing Agency will:

1. Review mix designs, certificates of compliance, and samples of materials the Contractor proposes to use

.

2. Test and inspect materials, as necessary, in accordance with ACI 318 and CBC Chapter 19A for compliance with requirements

3. Take samples as required from the Contractor's designated sources.

4. Take one grab sample for each 100 tons of Portland cement except that, when used in bulk loading ready-mix plants where separate bins for pre-tested cement are not available, take grab samples for each shipment of cement placed in bin with not less than one sample being taken for each day's pour and subsequently test such samples if required by the Landscape Architect who may be so advised by the Division of the State Architect (DSA).

5. Test both coarse and fine aggregate by use of solution of sodium or magnesium sulfate, or both whenever in the judgment of the Landscape Architect such tests are necessary to determine quality of material. Perform such tests in accordance with ASTM C88. Loss shall not exceed 6-percent of either fine or coarse aggregate. Aggregate failing to comply with this requirement may be used in the Work provided it contains less than 2- percent of shale and other deleterious particles and shows a loss in soundness test of not more than 10-percent when tested in the sodium sulphate solution. Test aggregates as required by CBC Section 1903A.3.

6. Test for sand equivalent of fine aggregate in accordance with California Test 217.

7. Test for cleanness value of coarse aggregate in accordance with California Test 227.

8. Inspect plant prior to any work to verify following:

a. Plant is equipped with approved metering devices for determining moisture content of fine aggregate.

b. Other plant quality controls are adequate.

9. Continuously inspect quality and quantity of materials used in transit mixed concrete, in batched aggregates and ready-mixed concrete at mixing plant or other location per CBC Chapter 19A where other materials are measured.

B. Waiver of Batch Plant Inspection:

1. Continuous batch plant inspection may be waived in accordance with CBC Chapter 19A if the plant complies with ASTM C94 and has been certified by an agency acceptable to DSA to comply with the requirements of the National Ready Mix Concrete Association.

2. When batch plant inspection is waived, the following requirements shall apply:

a. Testing Agency shall check the first batching at the start of work and furnish mix proportions to the licensed Weighmaster.

b. Licensed Weighmaster shall identify material quantities and certify each load by a ticket.

c. Project Inspector shall collect truck mix tickets with load identification and maintain a daily record of placement. Trucks without a load ticket identifying the mix shall be rejected. Copies of daily placement record shall be submitted to DSA.

d. At the end of the project, the Weighmaster shall submit an affidavit to DSA certifying that all concrete supplied conforms to proportions established by mix designs.

2.10 GEOCOMPOSITE MATERIAL (Enkadrain)

A. Enkadrain 3811R (or Sika equivalent) geocomposite drainage mat available from Colbond Inc., Enka, NC, www.colbond-usa.com, 800-365-7391.

B. Waterproofing System: MFM Subseal 60 Sheet Membrane Prime-A-Seal Primer and Mastic+Plus available from MFM Building Products, Coshocton, OH, (800) 882-7663, http://www.mfmbp.com/watermem.html, Local representative: Don Lambrecht & Associates, Inc., Rocklin, CA. 95677, 916-632-2059.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Install all concrete work true to line and grade as indicated on the drawings.

B. Correct irregularities to the satisfaction of the Landscape Architect.

3.2 PREPARATION

A. Take every precaution to obtain a subgrade of uniform bearing power by compaction to provide a firm base.

B. Subgrade shall be kept moist and shall not be allowed to dry out before placement of concrete. Place no material on muddy subgrade.

C. Aggregate base, where indicated, shall be placed and compacted in conformance with CalTrans Standard Specifications 26-1.04 and 26-1.05.

D. Obtain acceptance of subgrade from Project Inspector prior to placing steel and concrete.

3.3 FORMS

A. Forms shall be constructed in accordance with ACI 347 and shall be of sufficient strength and sufficiently tight to prevent visible distortion or leakage of mortar and fines.

B. Forms for exposed surfaces shall be designed to protect intended finish. Deflection of facing material between studs shall not exceed 0.0025 of the span. Facing material and pattern of joints shall be as accepted by the Project Inspector.

C. For vertical surface of wall footings below grade, clean-cut trench may be used in lieu of form if character of soil will permit installation without sluffing and width of concrete is increased at least 1 inch beyond indicated dimension of each face poured against earth.

D. Curb, mow band and pavement edge forms shall extend full depth of concrete. Curves shall be formed with flexible metal or wood made up of thin laminations. Curve forms shall extend one stake space straight beyond tangent point.

E. Maintain forms within the following tolerances.

1. Top of Form: Plus or minus 1/8 inch in 10 feet and no abrupt variations; at required elevation to plus 3/8 inch.

2. Face of Form: Plus or minus 1/4 inch in 10 feet longitudinal and no abrupt variations; perpendicular to surface plus or minus 1/8 inch.

F. Obtain approval of formwork from Project Inspector prior to placing concrete.

G. Forms may be reused upon cleaning and coating with parting compound to ensure separation from concrete without damage.

H. After concrete is placed, the following minimum times shall elapse before removal of forms.

1. Footing sides: 24 hours.

2. Walls and benches: 48 hours.

3. Curbs: 1 hour.

3.4 REINFORCEMENT

A. All concrete shall be steel reinforced unless specifically noted to be "not reinforced." If no reinforcement is shown, reinforce in same manner as that shown in similar places.

B. Fabricate and place reinforcement as indicated on the Drawings and in accordance with ACI "Detailing Manual" SP-66. No reinforcement shall be placed prior to distribution of the accepted shop drawings.

C. Secure reinforcement in position by suitable supports and by wiring at intersections with tie wire. Supports shall be of sufficient number and strength to resist crushing or displacement under full load. Metal shall not extend to surface of concrete.

D. At time of placing concrete, reinforcing shall be free of excessive rust, mill scale, or other bond reducing matter. Immediately before placing concrete, check and adjust position, support and anchorage.

3.5 PLACING CONCRETE

A. The Inspector of Record, Architect, Structural Engineer, Testing Laboratory and DSA shall be notified at least 48 hours before placing concrete.

B. Place concrete in accordance with ACI 304, CBC Sections 1905A.9 and 1905A.10 and as specified.

C. Place concrete in cycles as a continuous operation to permit proper and thorough integration and to complete scheduled placement. Place no concrete where sun, wind, heat, or facilities prevent proper finishing and curing.

D. Convey concrete as rapidly and directly as practicable to preserve quality and to prevent separation from rehandling and flowing; do not deposit concrete initially set. Cast concrete within ninety (90) minutes after adding water unless otherwise noted. Retempering of concrete which has partially set will not be permitted.

E. Take precautions to avoid damage to under-slab moisture barrier and displacement of reinforcement and formwork.

F. Deposit concrete vertically in its final position. Avoid free falls in excess of six feet where reinforcement will cause segregation and in typical conditions unless the Architect approves otherwise.

G. Keep forms and reinforcement clean above pour line by removing clinging concrete with wire brush before casting next lift. Also remove leakage through forms.

H. Interruption in casting longer than 60-minutes shall be cause for discontinuing casting for remainder of day. In this event, cut back concrete and provide construction joints as the Architect directs; clean forms and reinforcement as necessary to receive concrete at a later time.

I. Hot Weather Concreting: Conform to ACI 305 and following requirements when mean daily temperature rises above 75 degrees Fahrenheit.

1. An upper temperature limit of concrete mixes shall be established by the Contractor for each class of concrete. Concrete temperature during placing shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints, and

shall not exceed 90°F. Other project climatic conditions detrimental to concrete quality such as relative humidity, wind velocity, and solar radiation shall also be considered.

2. Trial batches of concrete for each mix design shall be made at the limiting mix temperature selected. In lieu of trial batches, compression strength test reports (20 minimum) at the limiting temperature for each proposed mix shall be submitted to the Owner's testing laboratory for review.

3. Practices to maintain concrete below maximum limiting temperature shall be in accordance with ACI 305. Concrete ingredients may be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for part of the mixing water.

4. Practices to avoid the potential problems of hot weather concreting shall be employed by the Contractor in accordance with ACI 305.

5. When the temperature of the reinforcing steel or steel deck forms is greater than 120°F, reinforcing and forms shall be sprayed with water just prior to placing the concrete.

J. Cold Weather Concreting:

1. No placement of concrete will be allowed at temperatures below 20 degrees Fahrenheit or if mean daily temperature for curing period is anticipated to be below 20 degrees Fahrenheit.

2. No concrete placement will be allowed on frozen subgrade.

3. Conform to ACI 306 and following requirements when mean daily temperature falls below 40 degrees Fahrenheit.

a. Reinforcement, forms or ground to receive concrete shall be completely free from frost.

b. Concrete at time of placement for footings shall have temperature no lower than 50 degrees Fahrenheit, for all other concrete this minimum temperature at time of placement shall be 60 degrees Fahrenheit. Maximum temperature shall be 90 degrees Fahrenheit.

c. Concrete shall be maintained at temperature no lower than 50 degrees Fahrenheit for minimum 7-day period after placement by means of blanket insulation, heaters, or other methods as approved by the Landscape Architect.

d. Use of calcium chloride or admixtures containing calcium chloride as accelerators will not be permitted.

e. The Contractor shall keep a record of concrete surface temperature for first 7-days after each pour. This record shall be open to inspection by the Inspector.

K. Consolidating:

1. Use vibrators for thorough consolidation of concrete.

2. Provide vibrators for each location during simultaneous placing to ensure timely consolidation around reinforcement, embedded items and into corners of forms; ensure availability of spare vibrators in case of failures. Vibrate through full depth of freshly placed concrete.

3. Do not place vibrators against reinforcement, attach to forms, or use to spread concrete.

4. Exposed Concrete: Vibrate with rubber type heads and, in addition, spade along forms with flat strap or plate.

L. Construction Joints:

1. Verify location and conformance with typical details; provide only where designated or approved by the Landscape Architect. Comply with CBC Section 1906A.4.

2. All horizontal and vertical construction joints to be thoroughly sandblasted to clean and roughen entire surface to minimum 1/4-inch relief exposing clean coarse aggregate solidly embedded in mortar matrix.

3. Just prior to depositing concrete, the surface of the construction joint shall be thoroughly wetted.

M. Walls and Other Formed Elements:

1. Space points of deposit to eliminate need for lateral flow. Placing procedures of concrete in forms permitting escape of mortar, or flow of concrete itself, will not be permitted.

2. Level top surface upon stopping work.

3. Take special care to fill each part of the forms by depositing concrete directly as near final position as possible, and to force concrete under and around reinforcement, embedded items, without displacement.

4. After concrete has taken its initial set, care shall be exercised to avoid jarring forms or placing any strain on ends of projecting reinforcement.

5. Where backfill is placed against a wall, it shall be adequately shored until it has attained design strength.

N. Precast Truncated Dome Pavers:

1. Install as shown on the Drawings and per manufactures' specifications and consistent with the accepted mock up.

2. Space joints consistently and as acceptable to the architect.

3. Clean and seal pavers as specified by manufacturer.

3.6 JOINTS AND GROOVES

A. Plane of joints shall be perpendicular to surface. Where new pavements join existing, joints shall align.

B. Score Joints: Form in the fresh concrete using a jointer to cut the groove so that a smooth uniform impression is obtained to 1" depth unless shown otherwise. All joints shall be struck before and after brooming. Tool concrete both sides of joint.

C. Expansion Joints and Edging: Provided at the location and intervals as shown on the drawings, and at all locations where concrete paving abuts buildings, walls, pillars, curbs or other structures. Fiber joint material shall be placed with top edge 1/2" below the paved surface to allow space for sealant, and shall be securely held in place to prevent movement. Metal key joint material shall be placed flush with top edge of the paved surface, and shall be securely held in place to prevent movement. Joint and other edges shall be formed in the fresh concrete using an edging tool to provide a smooth uniform impression. All edges shall be struck before and after brooming.

D. Sealed Joints: After the curing period, fiber expansion joints shall be carefully cleaned and filled with accepted joint sealant to just below adjacent paved surface in such a manner as to avoid spilling on paved surfaces or overflowing from joint.

E. Construction Joints: Place construction joints at the end of pours and at locations where placement operations are stopped for a period of more than one half hour, except where such pours terminate at expansion joints.

1. Construction joints shall be keyed with formed tongue and groove.

2. Tool concrete edge both sides of construction joint.

3.7 FINISHING

A. Flatwork and Curbs:

1. The finish surface of concrete paving along accessible routes of travel shall be at least as slip resistant as medium broom finish perpendicular to the path of travel for slopes under 6%, and slip resistant heavy broom finish perpendicular to the path of travel at slopes 6% or greater. See the landscape drawings for specified finishes.

2. Surface Finishes:

a. Float Finish (typical preliminary finishing for slabs to receive other finishes): The surface of the slab shall be screeded and all surface water and laitance removed. Floating shall be started as soon as the screeded surface has stiffened sufficiently. Floating shall be performed by hand using a wood float and shall be the minimum necessary to produce a relatively smooth, level, even-textured surface.

b. Medium Broom Finish: After the slab has been float finished as described above, the surface shall be uniformly directional textured by coarse stable broom to match accepted mock up. Non-slip finish compliant with ADA requirements. Apply on concrete paving perpendicular to the path of travel.

c. Heavy Broom Finish: After the slab has been float finished as described above, the surface shall be uniformly directional textured by coarse stable broom to match accepted mock up. Non-slip finish compliant with ADA requirements perpendicular to the path of travel.

d. Medium Brush Finish (typical for curbs): After the front form is removed, exposed surface shall be toweled smooth and then given a uniform light texture with fine brush parallel to line of curb, to match accepted mock up.

3.8 CURING

A. General Requirements:

1. Take curing measures immediately after casting and for measures other than application of curing compound, extend for seven days. The Architect may recommend longer periods based upon prevailing temperature, wind and relative humidity. Comply with CBC Section 1905A.11.

2. Avoid alternate wetting and drying and fluctuations of concrete temperature.

3. Protect fresh concrete from direct rays of sun, rain, freezing, drying winds, soiling, and damage.

4. Do not permit curing method to affect adversely finishes or treatments applied to finish concrete.

B. Curing Method, Typical: Obtain the Landscape Architect's approval of alternate measures.

1. Keep forms and concrete surfaces moist during period forms are required to remain in place.

2. Apply curing compound per manufacturers' recommendations.

C. Cure exposed concrete in accordance with CalTrans Standard Specifications Section 90.

D. Only water or curing compounds that impart no permanent color or gloss shall be used for curing concrete.

3.9 CONCRETE SEALING

A. Seal all exposed surfaces according to manufacturer’s specifications.

3.10 FIELD QUALITY CONTROL

A. The Owner's Testing Agency will:

1. Perform testing in accordance with ACI 318 and CBC Section 1903A and 1905A.

2. Review concrete mix designs.

3. Inspect concrete and grout placement continuously.

4. Test concrete to control slumps according to ASTM C143.

5. Continuously monitor concrete temperature as it arrives on the site.

6. Test concrete for required compressive strength in accordance with CBC Section 1905A.6:

    a. Make and cure three specimen cylinders according to ASTM C31 for each 50 cubic yards, or fraction thereof, of each class poured at site each day.

    b. Retain one cylinder for 7-day test and two for the 28-day test.

    c. Number each cylinder 1A, 1B, 1C, 2A, 2B, 2C, etc; date each set; and keep accurate record of pour each set represents.

    d. Transport specimen cylinders from job to laboratory after cylinders have cured for 24-hours on site. Cylinders shall be covered and kept at air temperatures between 60 and 80 degrees Fahrenheit.

    e. Test specimen cylinders at age 7-days and age 28-days for specified strength according to ASTM C39.

    f. Base strength value on average of two cylinders taken for 28-day test.

7. Test and inspect materials, as necessary, in accordance with ACI 318, MM Test Method 227 (Coarse Aggregates) and MM Test Method 217 (Fine Aggregates), for compliance with requirements specified in this section.

B. The Contractor shall:

1. Submit ticket for each batch of concrete delivered to job site. Ticket shall bear the following information:

    a. Design mix number.

    b. Signature or initials of ready mix representative.

    c. Time of batching.

    d. Weight of cement, aggregates, water and admixtures in each batch with maximum aggregate size.

    e. Total volume of concrete in each batch.

    f. Notation to indicate equipment was checked for contaminants prior to batching.

2. Pay the Owner's Testing Agency for taking core specimens of hardened structure and testing specimen according to ASTM C88 and C42 when laboratory tests of specimen cylinders show compressive strengths below specified minimum.

3.11 CLEANING, PATCHING AND DEFECTIVE WORK

A. Where concrete is under strength, out of line, level or plumb, or shows objectionable cracks, honeycombing, rock pockets, voids, spalling, exposed reinforcement, signs of freezing or is otherwise defective, and, in the Architect's judgment, these defects impair proper strength or appearance of the work, the Landscape Architect will require its removal and replacement at the Contractor's expense.

B. Immediately after stripping and before concrete is thoroughly dry, patch minor defects, form-tie holes, honeycombed areas, etc., with patching mortar. Patch shall match finish of adjacent surface unless otherwise noted. Remove ledges and bulges.

C. Compact mortar into place and neatly file defective surfaces to produce level, true planes. After initial set, dress surfaces of patches mechanically or manually to obtain same texture as surrounding surfaces.

D. Rock Pockets:

1. Cut out to full solid surface and form key.

2. Thoroughly wet before casting mortar.

3. Where the Landscape Architect deems rock pocket too large for satisfactory mortar patching as described, cut out defective section to solid surface, key and pack solid with concrete to produce firm bond and match adjacent surface.

E. Cleaning

1. Ensure removal of bituminous materials, form release agents, bond breakers, curing compounds if permitted and other materials employed in work of concreting which would otherwise prevent proper application of sealants, liquid waterproofing, and other delayed finishes and treatments.

2. Where cleaning is required, take care not to damage surrounding surfaces or leave residue from cleaning agents.

3.12 PROTECTION

A. Protect concrete from injurious action of the elements and defacement of any nature during construction operations.

B. Protect exposed corners of concrete from traffic or use which will damage them in any way.

C. Make provisions to keep all exposed concrete free from latence caused by spillage or leaking forms or other contaminants. Do not allow laitances to penetrate, stain, or harden on surfaces which have been textured.

D. Remove and replace pavement that does not comply with requirements in this Section.

E. Protect pavement from damage. Do not permit construction traffic on concrete pavement. Exclude other traffic from pavement for at least 28 days after placement.

F. Maintain pavement free of stains, discoloration, dirt, and other foreign material. Sweep pavement not more than two days before date scheduled for Substantial Completion inspections.

3.13 PAVEMENT TOLERANCES

A. Comply with the following tolerances:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Dowels: 1 inch.
5. Vertical Alignment of Dowels: 1/4 inch.
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
7. Joint Spacing: 3 inches.
8. Contraction Joint Depth: Plus 1/4 inch, no minus.
9. Joint Width: Plus 1/8 inch, no minus.

3.14 DEFECTIVE CONCRETE

A. If any concrete work is not formed as indicated, is under strength concrete, is concrete is out of line, level or plumb, or showing objectionable cracks, honeycomb, rock pockets, voids, spalling or exposed reinforcing, it shall be removed, repaired or replaced as directed by the Landscape Architect.

B. The Contractor shall be responsible for quality of concrete in place color and finish and control of cracking and spalling. All exposed concrete shall have a consistent color and finish and be free from uncontrolled cracking and spalling. If any concrete work is not consistent color and finish and be free from uncontrolled cracking and spalling it shall be removed, repaired or replaced as directed by the Landscape Architect.

3.15 GEOCOMPOSITE MATERIAL

A. Apply waterproofing geocomposite material conforming to the manufacturer's specifications to a minus 2 inches below finished soil grade on soil side of retaining walls, deepened concrete curbs retaining bio-retention basins and planters.

B. Install MFM Subseal 60 Sheet Membrane Prime-A-Seal Primer and Mastic+Plus where shown on drawings and as required by geotechnical engineer. Request review of installation of Membrane by geotechnical engineer before covering with soil.

3.16 CLEANING

A. Section 01 70 00 Contract Closeout & Final Cleaning.

B. During construction, wash off work as quickly as possible when stains or splotches are unavoidable.

C. Upon completion, clean exposed surfaces carefully. Brushing and cleaning solution, if used, must be preceded and followed with a through rinsing of clear water. No sand-blasting will be allowed to clean surfaces.

D. Remove from premises; equipment, debris and surplus material needed for, or resulting from, this work. Remove all concrete waste from planting areas and legally dispose of it.

E. All work shall be left in a condition satisfactory to the Landscape Architect.

F. Perform Work under this Section to keep affected portions of building site neat, clean, and orderly. Remove, immediately upon completion of Work under this Section, surplus materials, rubbish, and equipment associated with or used in performance. Be aware that failure to perform clean-up operations within 24 hours of notice by Landscape Architect will be considered adequate grounds for having work done by others at no added expense to the Owner

END OF SECTION

SECTION 32 13 18

CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

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 31 20 00, Earth Moving

B. Section 32 12 16, Asphalt Paving

C. Section 32 13 13, Concrete Pavement

1.3 RELATED DOCUMENTS

A. Geotechnical Report: ***[Insert Report Name, Company and Date]***.

B. ASTM Standards
   1. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   2. A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
   3. C94, Standard Specification for Ready-mixed Concrete
   4. C150, Standard Specification for Portland Cement
   5. C260, Standard Specification for Air-Entraining Admixtures for Concrete

6. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
7. C494, Standard Specification for Chemical Admixtures for Concrete.
8. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Portland Cement
9. C1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
10. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
11. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

C. Caltrans Standard Specifications, 2015
1. Section 51: Concrete Structures
2. Section 73: Concrete Curbs and Sidewalks
3. Section 90: Concrete

1.4 DEFINITIONS

A. ASTM: American Society for Testing and Materials

1.5 SUBMITTALS

A. Follow submittal procedures outlined in Section 01 10 00, Supplemental General Requirements.

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 Plans. 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.

C. Reinforcing Steel Shop-Drawings

1.6 QUALITY ASSURANCE

A. Concrete shall be subject to quality assurance in accordance with Section 90 of the Caltrans 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 and other work.

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.

1.7 DESIGNATION

A. General: Whenever the 28 day compressive strength is designated herein or on the Plans is 3,600 psi 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 3,600 psi 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 90-2 of the Caltrans Standard Specifications.

B. Unless specified otherwise herein or on the Plans, portland cement concrete for curbs, gutters, sidewalks and their appurtenances such as island paving, curb ramps and driveways, shall be minor concrete as specified in Section 90-2 of the Caltrans Standard Specifications.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT

A. General: Type II or Type V cement conforming to the requirements of ASTM C150. Contractor may substitute pozzolan for portland cement in amounts up to 15% of the required mix unless high early strength concrete is specified. Pozzolan shall consist of Class F Fly Ash meeting the requirements of ASTM C618.

B. Color: Provide a coloring equivalent to 1 pound of lampblack per cubic yard. Add to the concrete at the central mixing plant.

2.2 AGGREGATE AND AGGREGATE GRADATION

A. General: Fine and coarse aggregates shall be ¾ inch maximum size; clean and crushed aggregate free of materials which may cause staining. Aggregates shall conform to the requirements of section 90-1.02C of the Caltrans Standard Specifications.

B. Aggregate Size and Gradation: Conform to the requirements of section 90-1.02C(4)(d) of the Caltrans Standard Specifications for 1-inch maximum combined aggregate.

2.3 WATER

A. General: Water shall be clean, free from injurious amounts of oil, alkali, organic matter, or other deleterious material, and not detrimental to concrete per ASTM C94. Water shall conform to the requirements of section 90-1.02D of the Caltrans Standard Specifications, for mixing and curing portland cement concrete and for washing aggregates.

2.4 CHEMICAL ADMIXTURES

A. Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material. Admixtures shall conform to the requirements of section 90-1.02E of the Caltrans Standard Specifications and as noted herein or on the Plans.
   1. Air-Entraining Admixture: ASTM C260/C260M
   2. Water-Reducing Admixture: ASTM C494/C494M, Type A
   3. Retarding Admixture: ASTM C494/C494M, Type B
   4. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D
   5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F
   6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G
   7. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II

2.5 CLASSIFICATION OF PORTLAND CEMENT CONCRETE

A. Unless specified otherwise herein or on the Plans, portland cement concrete for the following items shall be designated as follows:
   1. Curbs, Gutters, and Sidewalks: Minor concrete.
   2. Cast in Place Concrete Pipe: The concrete shall consist of a minimum of 564 pounds of portland cement per cubic yard of concrete.
   3. Thrust Blocks: The concrete shall have a minimum compressive strength of 3,000 psi.
   4. Sign and Fence Footings: The concrete shall consist of a minimum of 376 pounds of portland cement per cubic yard of concrete.
   5. Water, Storm, and Sanitary Structures: The concrete shall consist of a minimum of 564 pounds of portland cement per cubic yard of concrete.

2.6 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 D1751. 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 specified otherwise herein or on the Plans, expansion joint thickness shall be as follows:
   1. Concrete Slope Protection, Gutter Lining, Ditch Lining and Channel Lining: ½ inch
   2. Structures: As indicated

2.7 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 A615 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 A615 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 A1064. 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 A1064.

E. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site.

2.8 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. ***[Coordinate with Landscape Plans and specs]***

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. ***[Coordinate with Landscape Plans and specs]***

2.9 CURING AND SEALING MATERIALS

A. Curing Compounds:
1. Concrete surface repellent-vertical and/or flatwork: Repello surface treatment, invisible chemical treatment barrier system.
2. Curing and sealing-exterior: Colorcure concrete cureseal manufactured by L.M. Scofield Company or approved equal. Color-matched, water-based curing and sealing compound that complies with ASTM C309. ***[Coordinate with Landscape Plans and specs]***
3. Color Conditioned Decorative Portland Cement Concrete: LITHOCHROME colorwax manufactured by L.M. Scofield Company or approved equal. Color-matched, water-based curing and sealing compound that complies with ASTM C309. ***[Coordinate with Landscape Plans and specs]***

2.10 FORMS

A. Conform to the requirements of Section 73-1.03C and Section 90-1.03B(5) of the Caltrans Standard Specifications.

B. Tolerance: Not to deviate more than ¼ inch in 10 feet in grade and alignment.

2.11 PRECAST CONCRETE STRUCTURES

A. Conform to the following Sections of Caltrans Standard Specifications:
1. 51-7, Minor Structures
2. 70-5.02, Flared End Sections

2.12 CONCRETE VEHICULAR PAVEMENT

A. General: See Section 32 13 13, Concrete Pavement.

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 as determined by ASTM D1557.

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.

3.2 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 Consulting Engineer 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.

3.3 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.

3.4 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 ½) 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.

3.5 MIXING AND TRANSPORTING PORTLAND CEMENT CONCRETE

A. Transit mix concrete in accordance with the requirements of ASTM Designation C94. 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.

3.6 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.

3.7 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 51-2.04 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans.

B. Curing Compounds:
1. Regular Portland Cement Concrete: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
2. Color Conditioned Decorative Portland Cement Concrete: Apply in accordance with the manufacturer's written instructions. ***[Coordinate with Landscape Plans and specs]***

3.8 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.

3.9 DECORATIVE SURFACING CONSTRUCTION ***[COORDINATE WITH LANDSCAPE PLANS AND SPECS]***

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.

3.10 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 and 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 ACI 117 and as follows:

1. Elevation: ¼ inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10 foot long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches, unless otherwise indicated.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 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

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SECTION 32 13 75

CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Portland cement concrete curbs and gutters, sidewalk, curb ramps and driveways.

1.2 RELATED SECTIONS

A. Section 31 20 00, Earth Moving

B. Section 32 11 00, Pavement Base Course

C. Section 32 13 13, Concrete Pavement

D. Section 32 13 18, Cement and Concrete for Exterior Improvements

1.3 RELATED DOCUMENTS

A. Geotechnical Report: ***[Insert Report Name, Company and Date]***.

B. American society for Testing and Materials (ASTM)
   1. A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
   2. D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

C. Caltrans Standard Specifications, 2015
   1. Section 51: Concrete Structures
   2. Section 72: Slope Protection
   3. Section 73: Concrete Curbs and Sidewalks
   4. Section 90: Concrete

1.4 DEFINITIONS

A. ASTM: American Society for Testing Materials

B. ACI: American Concrete Institute

1.5 SUBMITTALS

A. Submittal procedures shall be as outlined in Section 01 10 00 – Supplemental General Requirements.

B. Concrete Mix Design: Have all concrete mixes designed by a testing laboratory and approved by the Owner. 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 Caltrans Standard Specifications.

B. Certifications:
   1. Provide Owner 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.
   2. Settlement of type and amount of any admixtures.
   3. Provide Owner, 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 Sections 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 72-5 of the Caltrans Standard Specifications; except that finishing shall be in accordance with Standard Specification Section 73, or as 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 3,600 psi 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 3,600 psi 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 90-2 of the Caltrans Standard Specifications.

B. Unless specified otherwise herein or on the Plans, portland cement concrete for curbs, gutters, sidewalks and their appurtenances such as island paving, curb ramps and driveways, shall be minor concrete as specified in Section 90-2 of the Caltrans Standard Specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Comply with requirements of Section 32 13 18, Cement and Concrete for Exterior Improvements.

2.2 PORTLAND CEMENT CONCRETE

A. Unless specified otherwise herein or on the Plans, portland cement concrete for items in this section shall be Minor Concrete as specified in Section 90-2 of the Caltrans Standard Specifications.

B. Design mix to produce normal-weight concrete consisting of portland cement, aggregate, water-reducing or high-range water-reducing admixture (superplasticizer), air-entraining admixture, and water to produce the following properties:

1. Compressive Strength:
   a. Typical: 3000 psi, minimum at 28 days, unless otherwise indicated.
   b. Curbs & Gutters: 3500 psi, minimum at 28 days.
2. Slump Limit: 8 inches minimum for concrete containing high-range water-reducing admixture (superplasticizer, limited to flatwork only); 4 inches for other concrete.
3. Water/Cement Ratio: 0.5

2.3 CURBS AND GUTTERS FORMS

A. Use flexible spring-steel forms or laminated boards to form radius bends. Tolerance: Not to deviate more than 1/4 inch in 10 feet in grade and alignment.

2.4 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 D1751. 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.

B. Unless noted otherwise herein or on the Plans expansion joint thickness shall be as follows:

1. Curbs, Curb Ramps, Island Paving, Driveways and Gutter Depressions: ¼ inch

2.5 REINFORCEMENT AND DOWELS

A. Comply with requirements of Section 32 13 18, Cement and Concrete for Exterior Improvements.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with requirements of Section 32 13 18, Cement and Concrete for Exterior Improvements.

B. Form, place and finish concrete curbs, gutters, walkways, island paving, valley gutters and driveway approaches in conformance with the applicable requirements of Section 73 of the Caltrans Standard Specifications as modified herein.

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.

3.2 SUBGRADE

A. Conform to Section 73-1.03B of Caltrans Standard Specifications.

3.3 SOIL STERILANT

A. Furnish and apply an oxidation granular preemergent soil sterilant to prepared subgrade or after installation of rock or aggregate base uniformly at the rate recommended by the manufacturer.

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 ½) 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 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. 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. 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.

3.7 EXPANSION JOINTS

A. Construct expansion joints incorporating premolded joint fillers at twenty (20) foot intervals in all concrete curbs, gutters, 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 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.

3.8 WEAKENED PLANE JOINTS

A. Construct weakened plane joints in concrete curbs, gutters, 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.

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.

C. 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.

3.9 FINISHING CONCRETE

A. Finish curb and gutter in conformance with the applicable requirements of Section 73 of the Caltrans Standard Specifications as modified herein.

B. Where monolithic curb, gutter and sidewalk is specified, separate concrete pours will not be allowed.

C. Provide a broom finish to all horizontal surfaces perpendicular to the path of travel on surfaces used by pedestrians:
   1. Sloped Less than 6%: Provide a medium salt (medium broom) finish by drawing a soft bristle broom across concrete surface, perpendicular to line of traffic, to provide a uniform fine line texture.
   2. Surfaces Sloped Greater than 6%: Provide a slip resistant (heavy broom finish) by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.10 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 edge forms in place at least 24 hours after pouring.

3.11 CONNECTING TO EXISTING CONCRETE IMPROVEMENTS

A. New curb or gutter 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 ½ 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.

3.12 FIELD QUALITY CONTROL

A. 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.

B. 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 Section 73 of the Caltrans Standard Specifications.

3.13 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

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SECTION 32 14 00

SLURRY SEAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall perform all work associated with Slurry Seal as shown and as specified herein including all labor, materials, equipment supplies, and facilities associated with providing a finished product satisfying all the requirements of the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. The Contractor shall submit, at least seven (7) working days before slurry seal placement commences, a laboratory report of test results and proposed mix design covering the specific materials to be used on the project. The percentage of asphaltic emulsion proposed in the mix design shall be within the percentage range specified herein.

1.3 RELATED SECTIONS

A. Section 32 17 23, Pavement Markings

1.4 RELATED DOCUMENTS

A. Caltrans Standard Specifications, 2015
   1. Section 37: Bituminous Seal

PART 2 - PRODUCTS

2.1 SLURRY SEAL

A. Slurry seal shall be Type II in accordance with Section 37-3 of the Caltrans Standard Specifications with the exceptions noted in these specifications.

2.2 AGGREGATE

A. Aggregate for Type II slurry seal shall be in accordance with Section 37-3.02A and 37-3.02B of the Caltrans Standard Specifications.

2.3 ASPHALTIC EMULSION

A. Asphaltic emulsion shall be Grade PMCQS1h, complying with Section 37-3B(3) of the Caltrans Standard Specifications.

B. The polymer within the asphalt emulsion shall be Neoprene, SBR, EVA, or SBS or approved equal. Solid polymer such as EVA, SBS, or approved equal shall be adequately blended into the asphalt prior to the asphalt prior to emulsification. If latex such as Neoprene, SBR or similar is used, the latex shall be "co-milled" into the emulsion through the water phase during manufacturing. Each load of polymer

asphaltic emulsion shall have a certificate from the asphalt emulsion manufacturing indicating that either asphalt blending or "co-milling" process is used. The certificate shall also state the percentage of the solid rubber polymer added, by weight of the asphalt, as well as the composition of the polymer. The addition of latex to the emulsion after emulsion manufacturing is prohibited.

2.4 WATER AND ADDITIVE

A. Water shall be of such quality that the asphalt will not separate from the emulsion before the slurry seal is in place in the work. If necessary for workability, a set-control agent that will not adversely affect the slurry seal may be used.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The application of Type II slurry seal shall conform to Section 37-3.03 of the Caltrans Standard Specifications with the exceptions noted in these Specifications.

1. The slurry seal shall be placed at a rate to produce 10 to 13 pounds of aggregate per square yard for Type II slurry, as required in these Specifications. The complete mixture shall be such that the slurry seal mixture has proper workability and will permit traffic flow within two (2) hours after placement without the occurrence of bleeding, raveling, polishing, separation, or other distress within 30 days after its placement.
2. Asphaltic emulsion shall be added at a rate of between 10 to 15 percent by weight of the dry aggregate. The extract rate will be determined by the Engineer. The quantity of asphaltic emulsion to be used in the slurry seal mixture will be determined by the design asphalt binder content, as approved by the Engineer, and the asphalt solid content of the asphaltic emulsion furnished.
3. The Contractor shall sweep all slurry seal streets seven (7) days after the application of slurry seal with a power sweeper.

3.2 PROPORTIONAL MIXING

A. The proportional mixing of slurry seal shall conform to Section 37-3.03B and 37-3.03C of the Caltrans Standard Specifications.

B. The mixer shall thoroughly blend all materials to form a homogenous mass before leaving the mixer.

3.3 SURFACE PREPARATION

A. All existing striping and pavement markers shall also be removed prior to the application of the slurry seal. The slurry shall be applied within 72 hours after the removal of pavement striping marker.

B. The complete street surface shall be power swept from face of curb to face of curb prior to the application of slurry seal. The Contractor shall provide cleaning method necessary to remove all dirt, vegetation, and loose materials from the pavement.

C. All material gathered shall be properly disposed of by the Contractor. The Contractor shall remove all plant material growing in the street or on the interface of the asphalt surface with the lip of concrete gutter prior to placing slurry.

D. Immediately preceding the slurry seal application, the Contractor shall cover all grates, slotted manholes, and other appurtenances on the pavement that would allow the entry of slurry; cover all manhole covers, water and gas valve box covers, monuments boxes, grates and other exposed facilitates with plastic oil resistant construction paper secured by tape or adhesive. The Contractor prior to the final set of the slurry shall uncover all covered manholes, valves, grates and boxes. All uncovered items shall be clean and meet the requirement of the Project Inspector.

E. All catch basin grates and hoods adjacent to the work or within 50 feet shall be covered to prevent slurry from entering the catch basin.

3.4 SPREADER BOX

A. The slurry mixture shall be spread by means of a controlled spreader box conforming to Section 37-3.03C of the Caltrans Standard Specifications.

B. The spreader box shall be clean and free of all slurry seal and emulsion at the start of each working shift.

3.5 SAND BLOTTER

A. A sand blotter shall be spread at selected driveways, intersections, and where required by the Engineer to accommodate pedestrian or vehicular traffic until the slurry set.

3.6 APPLICATION OF SLURRY SURFACE

A. The surface shall be fogged with water directly preceding the spreader. The slurry mixture shall be of the desired consistency when deposited on the surface. Total time of mixing shall not exceed four (4) minutes. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that the complete coverage is obtained. No lumping, balling or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted. If coarse aggregate settles to the bottom of the mix, the slurry will be removed from the pavement. No excessive breaking of the emulsion will be allowed in the spread box. No streaks such as those caused by oversize aggregate will be left in the finished pavement.

B. The entire pavement, including the area around curb return shall be covered from gutter lip to gutter lip. The ends of slurry seal streets shall be a clean, straight line created by placing 15 lb felt paper with a 30 in. minimum width to create the line.

C. Longitudinal joints must correspond with lane lines. You may request other longitudinal joint patterns if they do not adversely affect the slurry seal.

D. Spread slurry seal in full lane widths. Do not overlap slurry seal between adjacent lanes more than 3 inches.

E. Use kraft paper at transverse joints and over previously placed slurry seal to prevent double placement. Remove the paper after use. Use hand tools to remove spillage.

F. No excessive buildup, or unsightly appearance shall be permitted on longitudinal or transverse joints. Burlap drags shall be used and changed daily.

G. Approved squeegees shall be used to spread slurry in non-accessible areas to the slurry mixer. Care shall be exercised in leaving no unsightly appearance from handwork.

H. Slurry application will be stopped to allow sufficient time to allow slurry to cure prior to opening streets to traffic. Protect the slurry seal from damage until it has cured.

I. All gutter spills must be cleaned immediately.

3.7 WEATHER LIMITATIONS

A. The slurry seal shall not be applied when either atmospheric or pavement temperature is 55 degrees Fahrenheit and falling but may be applied when either the atmospheric or pavement temperature is above 45 degrees Fahrenheit and rising. The slurry seal shall not be applied during periods of abnormally high relative humidity.

3.8 SLURRY REPAIR

A. In the event that the applied slurry seal surface violates the project requirements or has the following conditions:
   1. Tire or wheel marks
   2. Longitudinal ridges
   3. Picked up or raveled areas
   4. Transverse ridges or bumps
   5. Washboarding or excessively rough sand blotters

B. The slurry seal shall be repaired as follows:
   1. The slurry seal shall be removed by a "PENHALL PROFILER" or equal and a full lane width pass of slurry seal applied in full compliance with these specifications.
   2. The Engineer may omit removal of the affected slurry seal if it would not affect the repair.

3.9 STRIPING

A. Temporary striping and legends shall be placed on the newly slurry sealed streets prior to the release of streets to traffic. These materials must be submitted to the Engineer for approval prior to installation.

B. Permanent striping shall be installed after seven (7) days but no later than ten (10) days after the slurry seal is complete in accordance with Section 32 17 23, Pavement Markings.

END OF SECTION

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SECTION 32 15 40 - DECOMPOSED GRANITE PAVING

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide decomposed granite paving as indicated on the drawings and as specified herein.

B. Related Work included elsewhere:

1. Section 31 23 00, Excavation and Fill

2. Section 32 11 00, Subgrade Preparation & Base Material

1.02 QUALITY ASSURANCE

A. Reference Standards

1. Perform all work in accordance with all applicable laws, codes and regulations required by the City of South San Francisco.

2. Reference to "Standard Specifications" shall mean the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.

B. Stipulations: At no point shall surface fail to drain.

1.03 SUBMITTALS:

A. Submit 1-quart sample for approval of each specified material.

B. Construct 4'-0" x 4'-0" mock up panel at job site with 2x4s and vibrate in place. Protect sample panel until decomposed granite paving work is accepted. Locate panel where directed by Landscape Architect.

C. Product data sheet for binding agent

PART 2 - MATERIALS

2.01 BASE

A. Conforming to Section 32 11 13, Subgrade Preparation & Base Material.

2.02 ROCK SURFACE

A. High quality crushed rock, well-graded as shown on drawings and shall conform to the following gradation.

Sieve Size	% Passing
#4	85-100
#8	55-80
#30	30-45
#200	10-20

Maximum dry density: 130 p.c.f.
Optimum moisture: 8.8%

B. The performance characteristics of the decomposed granite should not be impacted by minor variations of the gradation (+/- 10%).

2.03 BINDING AGENT

A. Granitecrete Admixture. Apply at the rate of (3) 85lb bags/cubic yard.

B. Available from multiple local retailers.

C. See www.granitecrete.com for more information and retailer options.

D. No known equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Earthwork and adjacent paving work shall be complete.

B. Complete finish grading and compaction to bring subgrades after final compaction to required grades and sections as indicated.

3.02 INSTALLATION

A. Install per manufacturer's recommendations for commercial applications.

B. Coordinate with improvements as indicated on the drawings.

C. Install headers as shown on drawings and set to finish grades.

D. Where noted on the drawings, install decomposed granite material with organic binding agent per this section and manufacturer's specifications; compacted as shown on drawings to achieve a smooth uniform surface.

E. Where noted on the drawings, install decomposed granite material without organic binding agent per this section and manufacturer's specifications, uncompacted.

F. Redress surface of decomposed granite areas with fines as necessary to correct any settlement, rutting, erosion or lack of cross slope which develops after initial placement. Water and thoroughly compact surface until uniformly compacted.

G. Remove and replace decomposed granite paving that is damaged, defective, or does not meet requirements of this section.

H. Maintain surface free of erosion and weeds through project acceptance.

3.03 CLEANUP: Per Section 01 77 00

END OF SECTION

SECTION 32 17 13

PARKING BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete precast wheel stops.

1.2 RELATED SECTIONS

A. Section 01 00 00, Supplemental General Requirements

1.3 SUBMITTALS

A. Follow submittal procedure outlined in accordance with Section 01 10 00, Supplemental General Requirements.

B. Submit product data for each type of product.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 2500 psi minimum compressive strength, 5½ inches high by 7½ inches wide by 48 inches long (or length as shown on plans). Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed vertical holes through wheel stop for anchoring to substrate.

1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
2. Mounting Hardware: Galvanized-steel dowel, ½ inch diameter, 24 inch minimum length.

2.2 MANUFACTURERS

A. 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. Oldcastle Precast
2. Bertelson Precast
3. Barco Products, or approved equal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Install wheel stops in bed of adhesive before anchoring.

C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION

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SECTION 32 17 23

PAVEMENT MARKINGS

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

H. Survey monuments

1.2 RELATED SECTIONS

A. Section 01 10 00, Supplemental General Requirements

B. Section 32 13 18, Cement and Concrete for Exterior Improvements

1.3 RELATED DOCUMENTS

A. Caltrans Standard Specifications, 2015
   1. Section 78, Incidental Construction
   2. Section 81, Miscellaneous Traffic Control Devices
   3. Section 82, Signs and Markers
   4. Section 84, Markings

B. Caltrans Standard Plans, 2015
   1. Plan A20A through A20D: Pavement Markers and Traffic Lines, Typical Details
   2. Plan A24A and A24B: Pavement Markings Arrows
   3. Plan A24C: Pavement Markings, Symbols and Numerals
   4. Plan A24D: Pavement Markings, Words
   5. Plan A24E: Pavement Markings, Words, Limit and Yield Lines
   6. Plan A24F: Pavement Markings, Crosswalks
   7. Plan A73A: Object Markers
   8. Plan A73B: Markers
   9. Plan A73C: Delineators, Channelizers and Barricades
   10. Plan A74: Survey Monuments

11. Plan RS1: Roadside Sign, Typical Installation Details No. 1
12. Plan RS2: Roadside Sign, Wood Post - Typical Installation Details No. 2
13. Plan RS3: Roadside Sign, Laminated Wood Box Post - Typical Installation Details No. 3
14. Plan RS4: Roadside Sign, Typical Installation Details No. 4

C. The State of California Traffic Manual, 2014

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.

E. Professional Land Surveyor's Act, Business and Professions Code §§ 8700 – 8805

1.4 SUBMITTALS

A. Submit product data for each of the following in accordance with Section 01 10 00, Supplemental General Requirements:
1. Traffic paint
2. Pavement markers and adhesives
3. Reflectorized markers and posts

1.5 QUALITY ASSURANCE

A. Deliver certificates showing conformance with this specification to the Owners Representative with each shipment of materials and equipment to the Project site.

B. Provide proper facilities for handling and storage of products to prevent damage. Where necessary, stack products off ground on level platform, fully protected from weather.

1.6 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. Thermoplastic striping and marking materials shall be in accordance with Caltrans Standard Specifications Sections 84-2.02 and 84-2.02B, unless noted otherwise herein or on the Plans.

B. Glass Beads shall be in accordance with Caltrans Standard Specification Section 84-2.02D, Glass Beads, unless noted otherwise herein or on the Plans.

C. Thermoplastic stripes and markings shall have a minimum skid friction value of BPN 35.

2.2 PAINTED STRIPES AND MARKINGS

A. Painted striping and marking materials shall be in accordance with Caltrans Standard Specifications Sections 84-2.02 and 84-2.02C, unless noted otherwise herein or on the Plans.

B. Glass Beads shall be in accordance with Caltrans Standard Specification Section 84-2.02D, Glass Beads, unless noted otherwise herein or on the Plans.

2.3 PAVEMENT MARKERS

A. Pavement Markers shall be in accordance with Caltrans Standard Specification Section 81-3, Pavement Markers, and as indicated on the Plans.

B. Material
1. Non-reflective Material shall be in accordance with Caltrans Standard Specification Section 81-3.02B, Non-Reflective Pavement Markers. ***[Specify type A or AY and select ceramic or plastic or indicate otherwise.]***
2. Retroreflective Material shall be in accordance with Caltrans Standard Specification Section 81-3.02C, Retroreflective Pavement Markers. ***[Specify type A or AY or indicate otherwise.]***

C. Adhesive:
1. Adhesive Material shall be in accordance with Caltrans Standard Specification Section 81-3.02D, Hot Melt Bituminous Adhesive. Adhesive shall be:
   a. Flexible
   b. Rapid or standard set at the option of the contractor.

2.4 TRAFFIC CONTROL SIGNS

A. General: Traffic control signs shall be in accordance with Caltrans Standard Specification Section 82-1, Signs and Markers.

B. Sign Panels shall be in accordance with Caltrans Standard Specification Section 82-2, Sign Panels. Conform type (regulatory or warning), size, shape and pattern to the State of California, Department of Transportation, Traffic Manual, edition in effect at the date of the Plans.

C. Posts:
1. Metal Posts shall be in accordance with Caltrans Standard Specification Section 82-3.02B, Metal Posts.
2. Wood Posts shall be in accordance with Caltrans Standard Specification Section 82-3.02C, Wood Posts.

D. Mounting Hardware shall be in accordance with Caltrans Standard Specification 82-3.02E, Sign Panel Fastening and Mounting Hardware, unless otherwise specified.

E. Post Foundations: Conform to Caltrans Standard Plans.

2.5 STREET NAME SIGNS

A. Conform to manufacturer, style, size, and shape shown on the Plans.

B. Posts: 2 inch inside diameter steel pipe unless noted otherwise on the Plans. Posts shall be in accordance with Caltrans Standard Specification Section 82-3.02B, Metal Posts.

C. Post Foundations: Portland cement concrete in accordance with Section 32 13 18, Cement and Concrete for Exterior Improvements.

2.6 REFLECTORIZED OBJECT MARKERS

A. Reflectorized Metal Object Markers: In accordance with Caltrans Standard Specification Section 82-5, Markers, for target plates and reflectors, and Caltrans Standard Plans A73A through A73C. Marker type shall be as shown on Plans. ***[Select type of object marker.]***

B. Posts: Metal posts shall be in accordance with Caltrans Standard Specification Section 82-5.02C, Metal Posts, and Caltrans Standard Plan A73B.

C. Mounting Hardware: In accordance with Caltrans Standard Specification Section 82-5.02G, Hardware.

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. Waste from removal of yellow painted traffic stripe may contain lead chromate. Residue produced when yellow paint is removed may contain heavy metals in concentrations that exceed thresholds established by the California Health and Safety Code and may produce toxic fumes when heated. As such, when grinding or other methods approved by the Owner's Representative are used to remove yellow painted traffic stripes, the removed residue, including dust, shall be collected and contained immediately. The Contractor shall submit a written work plan for the removal, storage, and disposal of yellow painted traffic stripe to the Owner's Representative for approval not less than fifteen (15) days prior to the start of the removal operations. Removal operations shall not be started until the Owner's Representative has approved the work plan.

E. 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 minimum, 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 Caltrans Standard Specification Section 84-2.03, Construction, 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 Caltrans Standard Specification Section 84-3.03, 3.04 and 3.05 and Caltrans Standard Plans A20A through A20D, and A24A through A24F.

3.5 PAVEMENT MARKERS

A. Place in accordance with Caltrans Standard Specification Section 81-3.03, Construction.

B. Pavement recesses are not required. Markers shall be installed accurately to the line established by the Owner’s Representative. No markers shall be installed until the surface has been approved by the Owner’s Representative.

3.6 TRAFFIC CONTROL SIGNS

A. Install in accordance with Caltrans Standard Specification Sections 82-2.03 and 82-3.03, 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 accordance with Caltrans Standard Specification Section 82-5.03, Construction, 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 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.

3.10 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

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SECTION 32 17 26

TACTILE WARNING SURFACES

PART 1 - - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Cast In Place Detectable/Tactile Warning Surface Tiles.

B. Surface Applied Detectable/Tactile Warning Surface Tiles.

1.3 RELATED SECTIONS

A. Section 32 1313 “Pedestrian Concrete Paving” for concrete walkways and finishes, aprons, curbs and gutters.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s literature describing products, installation procedures and routine maintenance.

B. Samples for Verification Purposes: Submit two tile samples minimum 6” x 6” for each kind indicated.

C. Shop drawings are required for products specified showing fabrication details, composite structural system, tile surface profile, sound on cane contact amplification feature, plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.

D. Material Test Reports: Submit complete test reports from qualified accredited independent testing laboratory’s to qualify that materials proposed for use are in compliance with requirements and meet or exceed the properties indicated on the specifications. All tests shall be conducted on a Cast In Place Detectable/Tactile Warning Surface Tile system as certified by a qualified independent testing laboratory and be current within a 24 month period.

E. Maintenance Instructions: Submit copies of manufacturer’s specified installation and maintenance practices for each type of Detectable Warning Surface Tile and accessory as required.

1.5 QUALITY ASSURANCE

A. Provide Detectable/Tactile Warning Surface Tiles and accessories as produced, engineered and field tested products by a single manufacturer with a minimum of three (3) years experience in the manufacturing of Cast in Place Detectable/Tactile Warning Surface Tiles.

B. Installer's Qualifications: Engage an experienced Installer certified in writing by Detectable/Tactile Warning Surface Tile manufacturer as qualified for installation, who has successfully completed installations similar in material, design, and extent to that indicated for Project.

C. California Code of Regulations (CCR): Provide only approved DSAAC detectable warning products as provided in the California Code of Regulations (CCR) Title 24, Part 2, Section 205 definition of "Detectable Warning". Section 1117A.4 and 1127B.5 for"Curb Ramps" and Section 1133B.8.5 for "Detectable Warnings at Hazardous Vehicular Areas".

D. Americans with Disabilities Act (ADA): Provide Detectable/Tactile Warning Surface Tiles which comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title III Regulations, 28 CFR Part 36 ADA Standards For Accessible Design, Appendix A, Section 4.29.2 Detectable Warnings On Walking Surfaces).

1.6 DELIVERY, STORAGE AND HANDLING

A. Detectable/Tactile Warning Surface Tiles shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy plastic wrappings to protect tile from concrete residue during installation and tile type shall be identified by part number.

B. Detectable/Tactile Warning Surface Tiles shall be delivered to location at building site for storage prior to installation.

1.7 SITE CONDITIONS

A. Environmental Conditions and Protection: Maintain minimum temperature of 40°F in spaces to receive Detectable/Tactile Warning Surface Tiles for at least 24 hours prior to installation, during installation, and for not less than 24 hours after installation.

B. The use of water for work, cleaning or dust control, etc. shall be contained and controlled and shall not be allowed to come into contact with the general public. Provide barricades or screens to protect the general public.

1.8 WARRANTY

A. Cast In Place Detectable/Tactile Warning Surface Tiles shall be guaranteed in writing for a period of five (5) years from date of final completion. The guarantee includes defective work, breakage, deformation, fading and loosening of tiles.

B. Surface Applied Detectable/Tactile Warning Surface Tiles shall be guaranteed in writing for a period of five (5) years from date of final completion. The guarantee includes defective work, breakage, deformation, fading and loosening of tiles.

1.9 SEQUENCING

A. Coordinate with work as specified in Section 03 3000 "Cast-in-Place Concrete".

PART 2 - - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: The design based on VPC Cast-in-Place Detectable/Tactile Warning Surfaces manufactured by Engineered Plastics Inc. Williamsville, NY tel (800-682-2525), www.armor-tile.com .

2.2 DETECTABLE WARNING TILES

A. Vitrified Polymer Composite (VPC) Cast in Place Detectable/Tactile Warning Surface Tiles shall be an epoxy polymer composition with an ultra violet stabilized coating employing aluminum oxide particles in the truncated domes. The tile shall incorporate an in-line pattern of truncated domes measuring nominal 0.2" height, 0.9" base diameter, and 0.45" top diameter, spaced center-to-center 2.35" as measured on a diagonal and 1.67" as measured side by side. For wheelchair safety the field area shall consist of a non-slip surface with a minimum of 40 - 90° raised points 0.045" high, per square inch.

1. Dimensions: Cast In Place Detectable/Tactile Warning Surface Tiles shall be held within the following dimensions and tolerances:
2. Specifiers Note: Edit section below by selecting desired length and width. Delete non-relevant dimensions.
3. Length and Width: [12x12] [24x24] [24x36] [24x48] [24x60] [36x48] [36x60] nominal, unless otherwise indicated.
4. Depth:
   a. Cast-In-Place - 1.375 (1-3/8") (+/-) 5% max.
   b. Surface Applied – 0.1875(+/-) 5% max.
5. Face Thickness: 0.1875 (1-3/8") (+/-) 5% max.
6. Warpage of Edge: 0.5% max.
7. Embedment Flange Spacing: shall be no greater than 3.1" center to center (for Cast-In-Place).
8. Color: Federal Color Number 33538. Color shall be homogeneous throughout the tile.
9. Water Absorption of Tile when tested by ASTM D 570-98 not to exceed 0.05%.
10. Slip Resistance of Tile when tested by ASTM C 1028-96 the combined Wet and Dry Static Co-Efficients of Friction not to be less than 0.80 on top of domes and field area.
11. Compressive Strength of Tile when tested by ASTM D 695-02a not to be less than 28,000 psi.
12. Tensile Strength of Tile when tested by ASTM D 638-03 not to be less than 19,000 psi.
13. Flexural Strength of Tile when tested by ASTM D 790-03 not to be less than 25,000 psi.
14. Chemical Stain Resistance of Tile when tested by ASTM D 543-95 (re approved 2001) to withstand without discoloration or staining - 10% hydrochloric acid, urine, saturated calcium chloride, black stamp pad ink, chewing gum, red aerosol paint, 10% ammonium hydroxide, 1% soap solution, turpentine, Urea 5%, diesel fuel and motor oil.
15. Abrasive Wear of Tile when tested by BYK - Gardner Tester ASTM D 2486-00 with reciprocating linear motion of 37± cycles per minute over a 10" travel. The abrasive medium, a 40 grit Norton Metallite sand paper, to be fixed and leveled to a holder. The combined mass of the sled, weight and wood block is to be 3.2 lb. Average wear depth shall not exceed 0.060 after 1000 abrasion cycles when

measured on the top surface of the dome representing the average of three measurement locations per sample.

16. Resistance to Wear of Unglazed Ceramic Tile by Taber Abrasion per ASTM C501-84 (re approved 2002) shall not be less than 500.
17. Fire Resistance of Tile when tested to ASTM E 84-05 flame spread shall be less than 15.
18. Gardner Impact to Geometry "GE" of the standard when tested by ASTM D 5420-04 to have a mean failure energy expressed as a function of specimen thickness of not less than 550 in. lbf/in. A failure is noted when a crack is visible on either surface or when any brittle splitting is observed on the bottom plaque in the specimen.
19. Accelerated Weathering of Tile when tested by ASTM G 155-05a for 3000 hours shall exhibit the following result – $\Delta E < 4.5$, as well as no deterioration, fading or chalking of surface of tile color No 33538
20. Accelerated Aging and Freeze Thaw Test of Tile and Adhesive System when tested to ASTM D 1037-99 shall show no evidence of cracking, delamination, warpage, checking, blistering, color change, loosening of tiles or other detrimental defects.
21. Salt and Spray Performance of Tile when tested to ASTM B 117-03 not to show any deterioration or other defects after 200 hours of exposure.
22. AASHTO HB-17 single wheel HS20-44 loading “Standard Specifications for Highways and Bridges”. The Cast In Place Tile shall be mounted on a concrete platform with a ½” airspace at the underside of the tile top plate then subjected to the specified maximum load of 10,400 lbs., corresponding to an 8000 lb individual wheel load and a 30% impact factor. The tile shall exhibit no visible damage at the maximum load of 10,400 lbs (for Cast-In-Place).

2.3 ACCESSORIES

A. Fasteners: Color matched, corrosion resistant, flat head drive anchor: 1/4-inch diameter x 1 1/2-inch long as supplied by.

B. Adhesive: Adhesive as supplied by manufacture.

C. Sealant: Sealant as supplied by manufacture.

PART 3 - - EXECUTION

3.1 EXAMINATION & PREPARATION

A. During Cast in Place Detectable/Tactile Warning Surface Tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

B. Prior to placement of the Cast in Place Detectable/Tactile Warning Surface Tile system, review manufacturer and contract drawings with the Contractor prior to the construction and refer any and all discrepancies to the Engineer.

3.2 CAST-IN-PLACE INSTALLATION

A. The installation of the structural embedment flange system and related materials shall be in strict accordance with the contract documents and the guidelines set by their respective manufacturers. Not recommended for asphalt applications.

B. The physical characteristics of the concrete shall be consistent with the contract specifications while maintaining a slump range of 4 to 7 permitting solid placement of the Cast In Place Detectable/Tactile Warning Surface Tile system. An overly wet mix will cause the tile to float. Under these conditions, suitable weights such as 2 concrete blocks or sandbags (25 lb) shall be placed on each tile.

C. The concrete pouring and finishing operations require typical mason's tools, however, a 4' long level with electronic slope readout, 25 lb. weights, and a large non-marring rubber mallet are specific to the installation of the Cast in Place Detectable/Tactile Warning Surface Tile system. A vibrating mechanism such as that manufactured by Vibco can be employed, if desired. The vibrating unit should be fixed to a soft base such as wood, at least 1 foot square.

D. The factory-installed plastic sheeting must remain in place during the entire installation process to prevent the splashing of concrete onto the finished surface of the tile.

E. When preparing to set the tile, it is important that no concrete be removed in the area to accept the tile. It is imperative that the installation technique eliminates any air voids under the tile. Holes in the tile perimeter allow air to escape during the installation process. Concrete will flow through the large holes in each embedment flange on the underside of the tile. This will lock the tile solidly into the cured concrete.

F. The concrete shall be poured and finished true and smooth to the required dimensions and slope prior to the tile placement. Immediately after finishing concrete, the electronic level should be used to check that the required slope is achieved. The tile shall be placed true and square to the curb edge in accordance with the contract drawings. The Cast In Place Detectable/Tactile Warning Surface Tiles shall be tamped (or vibrated) into the fresh concrete to ensure that the field level of the tile is flush to the adjacent concrete surface. The embedment process should not be accomplished by stepping on the tile as this may cause uneven setting which can result in air voids under the tile surface. The contract drawings indicate that the tile field level (base of truncated dome) is flush to adjacent surfaces to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

G. In cold weather climates it is recommended that the Cast In Place Detectable/Tactile Warning Surface Tiles be set deeper such that the top of domes are level to the adjacent concrete on the top and sides of ramp and that the base of domes to allow water drainage.

H. Immediately after placement, the tile elevation is to be checked to adjacent concrete. The elevation and slope should be set consistent with contract drawings to permit water drainage to curb as the design dictates. Ensure that the field surface of the tile is flush with the surrounding concrete and back of curb so that no ponding is possible on the tile at the back side of curb.

I. While concrete is workable, a 3/8-inch radius edging tool shall be used to create a finished edge of concrete, then a steel trowel shall be used to finish the concrete around the tile's perimeter, flush to the field level of the tile.

J. During and after the tile installation and the concrete curing stage, it is imperative that there is no walking, leaning or external forces placed on the tile that may rock the tile causing a void between the underside of tile and concrete.

K. Following tile placement, review installation tolerances to contract drawings and adjust tile before the concrete sets. Two suitable weights of 25 lb each may be required to be

placed on each tile as necessary to ensure solid contact of the underside of tile to concrete.

L. Following the concrete curing stage, protective plastic wrap is to be removed from the tile surface by cutting the plastic with a sharp knife, tight to the concrete/tile interface. If concrete bled under the plastic, a soft brass wire brush will clean the residue without damage to the tile surface.

M. If desired, individual tiles can be bolted together using 1/4-inch or equivalent hardware. This can help to ensure that adjacent tiles are flush to each other during the installation process. Tape or caulking can be placed on the underside of the bolted butt joint to ensure that concrete does not rise up between the tiles during installation. Any protective plastic wrap which was peeled back to facilitate bolting or cutting, should be replaced and taped to ensure that the tile surface remains free of concrete during the installation process.

N. Tiles can be cut to custom sizes, or to make a radius, using a continuous rim diamond blade in a circular saw or mini-grinder. Use of a straightedge to guide the cut is advisable where appropriate.

O. Any sound-amplifying plates on the underside of the tile, which are dislodged during handling or cutting, should be replaced and secured with construction adhesive. The air gap created between these plates and the bottom of the tile is important in preserving the sound on cane audible properties of the tile system as required.

3.3 SURFACE APPLIED INSTALLATION

A. During all surface preparation and Surface Applied Detectable/Tactile Warning Surface Tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

B. The application of all tiles, adhesives, mechanical fasteners, and caulking shall be in strict accordance with the guidelines set by their respective manufacturers. Not recommended for asphalt applications.

C. Coordinate with the Contractor or Engineer to ensure that the surfaces being prepared and fabricated to receive the tiles are constructed correctly and adequately for tile installation. Review manufacturer and contract drawings with the Contractor prior to the construction and refer any and all discrepancies to the Engineer.

D. Set the tile true and square to the curb ramp area as detailed in the design drawings, so that its location can be marked on the concrete surface. A thin permanent marker works well. Remove tile when done marking its location.

E. The surface to receive the Surface Applied Detectable/Tactile Warning Surface Tile is to be mechanically cleaned with a diamond cup grinder or shot blaster to remove any dirt or foreign material. This cleaning and roughening of the concrete surface should include at least 4 inches around the perimeter of the area to receive the tile, and also along the cross pattern established by the corresponding areas on the backside of the tile. Those same areas should then be cleaned with a clean rag soaked in Acetone.

F. Immediately prior to installing the Surface Applied Detectable/Tactile Warning Surface Tile, the concrete surfaces must be inspected to ensure that they are clean, dry, free of voids, curing compounds, projections, loose material, dust, oil, grease, sealers and determined to be structurally sound and cured for a minimum of 30 days.

G. Using Acetone, wipe the backside of the tile around the perimeter and along the internal cross pattern, to remove any dirt or dust particles from the area to receive the adhesive.

H. Apply Armor-Bond adhesive to the backside of the tile, following the perimeter and internal cross pattern established by the tile manufacturer. Sufficient adhesive must be placed on the prescribed areas to have full coverage across the 2” width of the adhesive locator and shall be applied to within 1/4” continuously around the perimeter edge of the tile. The entire tube of adhesive shall be applied to the back of each tile, sizes 24” x 36”and greater.

I. Set the tile true and square to the curb ramp area as detailed in the design drawings.

J. Working from the center of the tile outwards, proceed to drill and install all fasteners in the tile’s molded recesses.

K. Standing with both feet applying pressure around the molded recess provided in the tile, drill a hole true and straight to a depth of 31/2” using a 1/4” masonry drill bit. Drill through the tile without hammer option (on the drill) until the tile has been successfully penetrated, then with hammer option (on the drill) to drill into the concrete. Maintaining foot pressure on both sides of the hole while drilling prevents concrete dust from accumulating between the tile and concrete which can affect the tile being installed flush and may compromise installation integrity.

L. Immediately after drilling each hole, before moving on to the next, and while still applying foot pressure, mechanically fasten tiles to the concrete substrate using a leather bound or hard plastic mallet to set the fasteners. Ensure the fastener has been placed to full depth in the dome, straight, and flush to the top of dome. Drive the pin of the fastener with the mallet, taking care to avoid any inadvertent blows to the truncated dome or tile surface.

M. Following the installation of the fasteners, the concrete dust should be vacuumed, brushed or blown away from the tile’s surface and adjacent concrete. Using Acetone on a rag, wipe the concrete around the tile’s perimeter to ensure a clean, dry surface to receive perimeter sealant.

N. Armor-Seal perimeter caulking sealant should be applied following the sealant manufacturer’s recommendations. Tape all perimeter edges of the tile back 1/16” from the tile’s perimeter edge and tape the adjacent concrete back 1/2” from the tile’s perimeter edge to maintain a straight and even caulking line. Apply sealant around tile perimeter using care to work sealant into any void between the tile and concrete interface. Tool the perimeter caulking with a rounded plastic applicator or spatula to create a cove profile between the tile and adjacent concrete. Remove tape immediately after tooling perimeter caulking sealant.

O. Do not allow foot traffic on installed tiles until the perimeter caulking sealant has cured sufficiently to avoid tracking. Curing time is weather dependant (average cure time at 75° F is 30 minutes). Adhesive or caulking on the surface of the Armor-Tile can be removed with Acetone.

P. If installing adjacent tiles, note the orientation of each tile. Careful attention will reveal that one of the long edges of the tile is different than the other in regard to the tiny dotted texture. You may also note a larger perimeter margin before the tiny dotted texture pattern begins. Consistent orientation of each Armor-Tile is required in order that the truncated domes on adjacent tiles line up with each other.

Q. In order to maintain proper spacing between truncated domes on adjacent tiles, the tapered edge should be trimmed off using a continuous rim diamond blade in a circular saw or mini-grinder. The use of a straightedge to guide the cut is required. All cuts should be made prior to installation of the tiles. If installing adjacent tiles, care should be taken to leave a 1/8 inch gap between each tile to allow for expansion and contraction.

R. If tiles are custom cut to size, if pre-molded recesses (to receive fasteners) are removed by the cut, or to maintain a tight installation to the substrate then any truncated dome can be center-drilled with a 1/4 inch masonry drill bit to create a through hole, and the through hole must be countersunk with a suitable carbide countersink bit to receive mechanical fasteners. Care should be taken to not countersink too widely or deeply. Fasteners should be flush with the top of the truncated dome when countersunk properly.

3.4 CLEANING, PROTECTING AND MAINTENANCE

A. Protect tiles against damage during construction period to comply with Tactile Tile manufacturer's specification.

B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.

C. Clean Tactile Tiles not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean Tactile Tile by method specified by Tactile Tile manufacturer.

D. Comply with manufacturers maintenance manual for cleaning and maintaining tile surface and it is recommended to perform annual inspections for safety and tile integrity.

END OF SECTION

SECTION 32 80 00 - IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Install irrigation system and electrical and signal conduits and boxes complete as shown and as specified.

B. Install a 3" main line, designed for a maximum flow of 70GPM. Point of connection to the 4" mainline, located at the northwest corner of the SSFHS baseball field, constructed in 2019.

1.2 RELATED SECTIONS

1. Section 01 11 00, Summary of Work
2. Section 31 00 00, Earthwork
3. Section 32 13 00, Concrete
4. Section 32 85 00, Landscape Drainage
5. Section 33 40 00, Storm Drainage

1.3 QUALITY ASSURANCE

A. Qualifications:

1. The contractor shall use an installer that complies with and submits written evidence of the following:
2. All irrigation sub-contractors bidding on this project must have a California license and be experienced in the installation, in Northern California, of irrigation systems for at least 5 years and have completed five (5) projects in Northern California of comparable size, type and complexity, in the past three (3) years.
3. Experience: Assign a full-time employee to the job as foreman for the duration of the Contract with a certified landscape technician, certification through CLCA or minimum of four (4) years experience in landscape installation and maintenance supervision, with experience or training in turf management, entomology, pest control, soils, fertilizers and plant identification.
4. Labor Force: Provide a landscape installation and maintenance force thoroughly familiar with, and trained in, the work to be accomplished to perform the task in a competent, efficient manner acceptable to the Owner.
5. Coordinate shutoff of irrigation systems with the Owner and be responsible for any damage caused to adjacent landscaping by Contract work.

B. Requirements:

1. Supervision: The foreman shall directly supervise the work force at all times and be present during the entire installation. Notify Owner's Representative of all changes in supervision.

2. Identification: Provide proper identification at all times for landscape maintenance firm's vehicles and a labor force uniformly dressed in a manner satisfactory to Owner's Representative.

C. Manufacturer's Specifications: Follow manufacturer's current printed specifications and Drawings in all cases where the manufacturers of articles used in the Contract furnish directions covering points not specified or shown in the drawings.

D. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the above codes, regulations or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality, higher standard, or larger size than is required by the above codes and regulations, the provisions of these Specifications and Drawings shall take precedence.

E. References, Codes and Standards

1. Title 23 Model Water Efficient Landscape Ordinance (MWELO) compliance.

2. Water Use Classification of Landscape Species (WUCOLS).

3. American Society of Irrigation Consultants (ASIC) Design Guidelines.

4. California Landscape Standards, California Landscape Contractors Association, Sacramento, California.

5. CAL-OSHA.

6. National Electric Code.

7. Uniform Plumbing Code (UPC) published by the Association of Western Plumbing Officials.

8. Underwriters Laboratories (UL): Electrical wiring, controls, motors and devices, UL listed and so labeled.

9. American Society of Testing Materials (ASTM).

10. California Building Code (CBC).

F. Explanation of Drawings:

1. Due to the scale of the Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affecting all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities, site improvements and architectural features.

2. Do not install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in arc dimensions exist that might not have been considered in engineering. Bring such obstruction or differences to the attention of the Landscape Architect. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary.

1.4 SUBMITTALS

A. Materials List:

1. Within thirty (30) days after the Notice to Proceed, submit manufacturer's cut sheets and complete lists of materials proposed for installation, and obtain the Landscape Architect's written approval thereof before proceeding. Use only accepted materials and items of equipment.

2. List all materials by manufacturer's name and model number.

B. Manuals:

1. Prior to the final acceptance of the irrigation system, furnish two (2) individually bound Owner's Manuals to the Landscape Architect for use by the Owner. The manual shall contain complete enlarged drawings, diagrams and spare parts lists of all equipment installed, showing manufacturer's name and address. In addition, each Owner's Manual shall contain the following:

a. Index sheet indicating the Contractor's name, address and phone number.

b. Copies of equipment warranties and certificates. Include certificate for irrigation controller and warranty for controller.

c. List of equipment with names, addresses and telephone numbers of all local manufacturers' representatives.

d. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate and maintain all equipment.

e. Parts list of all equipment such as valves.

C. Record Drawings:

1. Dimension the location of the following items from two (2) permanent points of reference such as building corners, sidewalks, road intersections, etc.:

a. Connection to existing water lines.

b. Connection to electrical power

c. Isolation valves.

d. Quick coupling valves.

e. All sleeve locations.

f. Routing of sprinkler pressure lines

g. Routing of all control wiring

h. Remote control valves

I. Include all invert elevations below 12".

2. Deliver one reproducible set of Record Drawings to the Landscape Architect within seven (7) working days before the date of Final Review. Delivery of the Record Drawings shall not relieve the Contractor of the responsibility of furnishing required information in the future.

D. Controller Plan:

1. Permanently install one "bubble diagram" controller plan adjacent to controller housing. The plan shall show the area controlled by each valve and any major permanent structure, such as buildings and roads.

2. Charts to be waterproof and installed as accepted by the Landscape Architect.

E. Maintenance Material - supply the following tools to the Owner:

1. Three (3) sets of specialized tools required for removing, disassembling and adjusting each type of box, valve or other equipment supplied on this project.

2. Two (2) quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Furnish and deliver materials in manufacturer's packaging, bearing original legible labeling.

B. Handle and store all equipment in accordance with manufacturer's current printed specifications.

1.6 SEQUENCING AND SCHEDULING

A. Acceptance: Do not install main line and lateral trenching prior to acceptance by Inspector of rough grades completed under another Section.

B. Coordination: Coordinate with the work of other sections to insure the following sequence of events:

1. Sleeves and Conduits: Installation of all sleeves and conduits to be located under paving and through walls prior to placement of those materials.

1.7 WARRANTY

A. In addition to manufacturer's guarantees or warranties, work shall be warranted for two (2) years from date of final acceptance against defects in material, equipment and workmanship. Warranty shall also cover repair of damage to any part of the premises

resulting from leaks or other defects in materials, equipment and workmanship to the satisfaction of the Owner.

B. Include a copy of the warranty forms in the Owner's Manual.

1.8 OPERATION

A. Routine: Inspect and adjust all valves, including raising or lowering of heights to accommodate finish grade.

B. System Failure: Perform all repairs within one (1) operating period. Replacements to match removed products and materials in all respects. Report promptly all damage not resulting from Contractor's operations. Repair all damage caused by Contractor at no expense to Owner.

C. Controller: Inspect regularly for power interruption and reset clock as required. Adjust station timing to accommodate changes in plant growth and weather conditions.

D. Climate Change: Set and program automatic controllers in response to seasonal requirements and requirements of newly planted materials.

E. Program automatic controller for climatologically controlling operation for at least 10 months of growing conditions before the end of the 12-month maintenance period. Obtain letter of certification from manufacturer's representative certifying the controller is properly programmed.

1.9 SOILS REPORT

A. A soil investigation report has been prepared for the project.

B. The reports are available in the office of the Architect and the Construction Manager for inspection by the Contractor. Unless otherwise specified, it is intended that all work be performed in accordance with the provisions of these reports.

C. According to the Geotechnical Engineer, drilled piers may encounter ground water. Excavations for drilled piers may require casings and installation of concrete by means of pumping under the direction of the Geotechnical Engineer.

1.10 SOILS BORINGS

A. Subsurface soils investigations have been made at the site and logs of the test holes are available with the Soils Report. Such investigations have been made for the purposes of design only, and neither the Landscape Architect, the Owner, nor the Soils Engineers guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations

PART 2 - PRODUCTS

2.1 PIPE

A. All piping shall be continuously and permanently marked with the manufacturer's name or trademark, nominal size, and schedule or class indicating the pressure rating.

B. Polyvinyl chloride (PVC) 1120-1220, Class 200 and Class 315 shall conform to ASTM D2241. Schedule 40 and 80 shall conform to ASTM D1785.

C. Piping on pressure side of irrigation control valves:

1. Pipe to be polyvinyl chloride (PVC) 1120-1220, Schedule 40, Class 200 and Class 315 as noted on below.

2. Sizes ¾", 1", 1-1/4", and 1-1/2": Use polyvinyl chloride (PVC) 1120-1220, Schedule 40 and with solvent weld Schedule 40 fittings.

3. Sizes 2", 2-1/2" and 3": Use polyvinyl chloride (PVC) 1120-1220, Class 315 with solvent weld Schedule 40 fittings.

D. Piping on non-pressure side of irrigation control valves:

1. Polyvinyl chloride (PVC) 1120-1220, SDR21.0, Class 200.

2. Polyvinyl chloride (PVC) 1120-1220, Schedule 40 for piping under paving.

2.2 FITTINGS

A. Fittings for Solvent Welded Pipe: Schedule 40 and Schedule 80, polyvinyl chloride, standard weight, as manufactured by Sloane, Lasco, or accepted equal, to meet ASTM D2466-73 and D2467-73.

2.3 NIPPLES

A. Plastic: Schedule 80, Type I, Grade 1 polyvinyl chloride (PVC); threaded both ends; ASTM D1784 and D1785; uniformly gray in color.

2.4 IRRIGATION CONTROLLER

A. Refer to Drawings.

2.5 CONTROL WIRES

A. Type: Copper with UL accepted for direct burial, size 14-1. Common ground wire with white insulating jacket; individual control wires with insulating jacket of color other than white. Use red wires for control valve wires and black wires for extra wires.

B. Splices: 'DBR', or 'DBY' by 3M.

2.6 REMOTE CONTROL VALVE

A. As shown on Drawings.

2.7 BOX FOR QUICK COUPLER VALVE BOXES

A. Concrete and as shown on Drawings or accepted equal. Cover with track surfacing where in track surfacing.

2.8 ISOLATION VALVE

A. For isolation valves 2-1/2" and larger: Specification: Nibco, Resilient Wedge Iron Body Gate Valve, model F-619-RW-SON, Flanged, non-rising stem or accepted equal. Match the line size.

B. For isolation valves 2" and smaller and for ball valve at remote control valve: Specification: KBI, Lo-Torque Schedule 80 Plastic Ball Valve or accepted equal. Match the line size or size of remote control valve.

C. For ball valve at remote control valve: Specification: KBI, Lo-Torque Schedule 80 Plastic Ball Valve or accepted equal. Match the line size or size of remote control valve.

2.9 ISOLATION VALVE BOXES

A. Round concrete box with, bolt-down lid, high-density, reinforced concrete with non-settling shoulders and traffic strength lid, Brooks #3-RT, Christy #G5, or equal.

2.10 DETECTION WIRE

A. Sheathed #12 copper wire.

2.11 SLEEVE AND CONDUIT MATERIALS

A. For Water Lines: PVC 1120-1220, Class 315 pipe.

B. For Conduits: PVC 1120-1220, Schedule-40 electrical conduit. Install pull ropes in empty conduits.

C. For Wires and Water Lines: Twice the diameter of the largest pipe going through the sleeve.

2.12 MISCELLANEOUS INSTALLATION MATERIALS

A. Solvent Cement and Primers for Solvent-weld Joints: Conforming to ASTM D2564 #P-70 primer and Weld-on #711 glue or make and type accepted by manufacturer(s) of pipe and fittings. Maintain cement proper consistency throughout use.

B. Teflon Tape: Use only Teflon tape on all threaded PVC fittings.

2.13 MISCELLANEOUS EQUIPMENT/ACCESSORIES

A. Concrete Pads: Poured-in-place concrete boxes and vaults.

B. Thrust Blocks: Concrete and the size shall be based on an average safe soil bearing load of 700 lbs. per square foot. See Concrete Section of Specifications.

C. Sleeves and Conduits: See Drawings.

2.14 PULL BOXES

A. As shown on the Drawings, Christy N-9 in AC paving and Comm Box specified in Section 12 93 05 in synthetic turf. Install synthetic turf on top of box in areas of synthetic turf. Install flush with finish grade.

2.15 OTHER EQUIPMENT

A. As shown on the Drawings.

2.16 REMOTE CONTROL VALVE TAGS

A. Christy remote control valve tags or accepted equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Sleeves and Conduits: Verify that all installed sleeving and conduits are undisturbed and are free of defects or errors introduced by the work of other sections.

B. Water Pressure: Test and verify that existing water pressure is the minimum pressure to operate the irrigation system as specified on the Drawings.

C. Stub-outs: Verify that all stub-outs to be provided under another contract are correctly sized, located and installed as noted on Drawings. Mark all below grade stub-outs, spare sleeves, and boxes.

D. Notification: Submit written notification to Inspector within ten (10) working days of above inspections describing all acceptable and non-acceptable site conditions.

3.2 CONNECTIONS TO SERVICES

A. Coordinate connection to r points of connection where applicable.

B. Field verify with Construction Manager the locations of connections to water sources, stub outs, backflow prevention devices, quick coupling valves, irrigation main line, comm. boxes, pull boxes and isolation valves.

C. Coordinate utility shut down with Construction Manager.

D. Field verify with Owner the locations of connections to water sources, stub outs, backflow prevention devices, irrigation controller, isolation valves, and remote control valves.

E. Refer to Planting Plan of location of valve boxes.

F. Coordinate connection of irrigation controllers to electrical power source. Contractor to connect to the power.

3.3 INSTALLATION

A. Conduits and Sleeves:

1. Coordination

a. Provide conduit and sleeve materials and coordinate installation with other trades.

b. Do not install other trades conduit, pipes or materials in irrigation trenches.

c. Coordinate location of electrical and signal conduits and boxes.

2. Extent: Install conduits and sleeves where control wires and pipes pass under paving or through walls as shown on Drawings. Extend twelve inches (12") beyond edges of paving and walls and cap ends until ready for use.

3. Install empty conduits for electrical and signal with empty pull rope as shown on Drawings. Use 2” minimum diameter or larger where noted on drawings.

4. Pull Boxes and Comm Boxes: Set square, and locate where shown on drawings or as otherwise directed. Install box flush with finish grade, not necessarily level. Locate boxes in synthetic turf outside of running and event areas. Install synthetic turf surfacing on exposed box tops in areas of synthetic turf.

B. Excavating and Trenching:

1. Dig trenches wide enough to allow a minimum of three inches (3") between parallel pipelines. Provide a minimum cover from finish grade as shown on drawings.

C. Pipe Line Assembly:

1. General:

a. Install pipe and fittings in accordance with manufacturer's current printed Specifications.

b. Clean all pipes and fittings of dirt, scales and moisture before assembly.

c. Thrust blocks:

(1) For irrigation mainlines which are 2 ½" diameter and greater, install thrust blocks at changes of direction and size changes greater than ½". Refer to Drawings.

(2) The size of the thrust blocks shall be per pipe manufacturer’s instructions and based on the maximum thrust force expected during test pressures as well as peak operating pressures and the load-bearing capacity of the soil.

(3) Install thrust blocks at shutoff valves.

(4) Install thrust blocks at the termination points of the mainline.

(5) Do not install Concrete or thrust blocks over valve wires.

(6) Do not conduct a pressure test within 48 hours of the thrust block pours.

2. Solvent-welded Joints for PVC Pipes:

a. Solvents: Use solvents and methods specified by pipe manufacturer.

b. Curing Period: Minimum of one (1) hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.

3. Threaded Joints for Plastic Pipes:

a. Quick Coupler Valve Swing Joint Assembly: Use non-hardening pipe joint compound.

b. Use Permatex on all other threaded PVC fittings.

c. Joining: Use strap-type friction wrench only. Do not use metal-jawed wrench. Assemble finger tight plus one or two turns.

4. Laying of Pipe:

a. Bedding On-grade: Remove from trench all rocks or clods. Bed pipe in at least 2 inches of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.

b. Snaking: Snake pipe from side to side of trench bottom to allow for expansion and contraction. Minimum allowance for snaking is one (1) additional foot per 100 ft. of pipe.

c. Moisture Restrictions: Do not lay PVC pipe when there is water in the trench. Do not assemble PVC pipe unless the pipe is dry.

D. Isolation Valves: Group valves together, aligned in a row where grouped, and locate where shown on drawings. Install box flush with finish grade, not necessarily level. Locate boxes outside of running and event areas.

E. Control Valves:
1. Install in valve boxes where shown on Drawings and group together where practical.
2. Manifold valves where connecting to the mainline.
3. Where two or more valves are installed adjacent to each other, provide at least twelve inches (12") separation. Align boxes in a row.
4. Permanently mark valve box lid with 2" black valve number and controller letter. Install remote control valve tags at each valve.

F. Automatic Controller:
1. General: Install per local code and manufacturer's current printed Specifications.
2. Connection to Valves: Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc. Match valve numbers as shown on Irrigation Plan.
3. Connect all controllers to lightning rod as required for lightning protection.
4. Labeling: Affix controller letter (i.e., "A") on inside of controller cabinet door with minimum of one-inch (1") high permanent letter.
5. Irrigation Diagram: Affix a non-fading, waterproof copy of irrigation diagram to cabinet door below controller name. Irrigation diagram to be sealed between two plastic sheets, 20 mil. minimum thickness. Use a reduced copy of the Record Drawing for the irrigation diagram clearly showing all valves operated by the controller, station, number, valve size, and type of planting irrigated. Color code area operated by each valve.
6. Connect controller to existing electrical power as required. Install per code and manufacturer's current printed Specifications.

G. Quick Coupling Valves:

1. Install in valve boxes where shown on Drawings.

2. Manifold valves where connecting to the mainline.

3. Set box lid flush with finish grade and cover with track surfacing or synthetic turf where applicable.

H. Closing of Pipe and Flushing of Lines:

1. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.

3.4 SLEEVING

A. Install sleeves where control wires and pipes pass through or under walls.

B. Install sleeves for control wiring and pipe under walks and paving as shown on the drawing and as required to facilitate a smooth construction sequence.

C. Sleeves to be of adequate size to accommodate retrieval for repair of wiring or piping and shall extend a minimum of 12" beyond edges of walls, walks and paving.

D. Coordinate sleeve installation with other trades as required.

E. Install one spare 3" diameter sleeve adjacent to sleeves shown on Drawings and required to complete work. Cap both ends and mark location on pavement as accepted by Inspector.

3.5 PIPELINE ASSEMBLY

A. Install pipe in accordance with manufacturer's instructions.

B. Solvent weld PVC pipe and fittings using primers, solvents and methods recommended by manufacturer, except where screw connections are required. Clean pipe and fitting of dirt and moisture before assembly. PVC pipe may be assembled on ground surface beside trench. Snake pipe from side to side of trench bottom to allow for expansion and contraction. Make all connections between PVC pipe and metal valves or pipe with threaded fittings using PVC male adapters.

C. Use Permatex pipe joint compound (#51D) on threaded PVC fittings, except for sprinkler heads. Assemble threaded PVC fittings finger tight plus one or two turns.

3.6 CONTROL WIRING

A. Install control wires with sprinkler mains and laterals in common trenches wherever possible. Lay to the side of pipeline. Tie wires in bundles at 10' intervals and allow slack for contraction between ties.

B. Provide a minimum of 30” of looped extra ground and control wire at each valve and at 200' intervals on long wire runs. Snake wires in trench to allow for contraction of wires.

C. Control wire splices at remote control valves to be crimped and sealed with specified splicing materials.

D. Line splices will be allowed only on runs of more than 2500'. Place splices inside of a valve box below grade and mark with a marker.

E. Install two additional wires in wire bundles for potential connection to controller. Run from farthest valve to controller without splices. More than two wires may be required due to branching of mainline. Install different color wire than active valve wire.

F. Crimp control wire splices at control valves. Seal with specified splicing materials. In-line splices will be allowed only on runs exceeding 2500 feet and only in junction boxes.

3.7 DETECTION WIRE

A. Install wire on top of the irrigation main supply line. Connect detection to each quick coupling valve stake to serve as a ground.

3.8 FIELD QUALITY CONTROL

A. Testing of Irrigation System:

1. Make hydrostatic tests with quick coupler valves installed and capped, remote control valves installed, flow valve open, ball valve open and laterals disconnected when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure. Keep all couplings and fittings exposed.

2. Install two (2) pressure gauges at opposite ends of mainline system. Pump system up to a minimum of 125 psi the day preceding the scheduled test and verify that pressure is holding. Inspect system early following day and immediately notify Inspector if the test confirmation must be postponed.

3. Apply continuous static water pressure of 125 psi in accordance with CalTrans Standard Specifications Section 20-5.03H, except after a drop in pressure (5 psi maximum), then the pressure must stabilize and remain stable for a one (1) hour minimum period before acceptance of the test.

4. Leaks resulting from tests shall be repaired and test repeated until system passes tests.

B. Adjustment of the System:

1. Flush and adjust for optimum performance.

2. When the irrigation system is completed, perform an operation test in the presence of the Inspector of each quick coupler valve.

3. Flush and adjust all sprinkler heads for optimum performance and to prevent over spray onto track, paving, walks, roadways and buildings.

4. Set all sprinkler heads perpendicular to finished grades unless otherwise noted on the Drawings.

5. When the landscape sprinkler system is completed, perform a coverage test in the presence of the Inspector to determine if the water coverage for planting and turf areas is adequate.

6. Test controllers individually in the presence of the Inspector and the Landscape Architect. Demonstrate that all control valves operate electronically.

7. Demonstrate to Landscape Architect that irrigation scheduling programmed into controller is adequate for plant requirements without causing runoff, and that scheduling capacities of controller are utilized.

3.9 BACKFILL AND COMPACTING

A. General: After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean soil, free of debris.

B. Backfill for All Trenches: Regardless of the type of pipe covered, compact to minimum 95% density under pavements and synthetic turf and 85% under planted areas.

C. Compacting: Compact trenches only in areas to be planted by thoroughly flooding the backfill. Jetting process may be used in those areas.

D. Finishing: Dress off areas to finish grades.

E. Owner's testing agency will test backfill compaction in areas under paving.

3.10 FLOW SENSOR AND MASTER VALVE

A. Install as required on the Drawings and in conformance with the manufacturer's General and Technical Specifications.

3.11 MAINTENANCE

A. The entire sprinkler irrigation system shall be under full automatic operation for a period of 2 days prior to any planting.

B. The Owner’s Representative reserves the right to waive or shorten the operation period.

C. Maintain/repair system for full duration of plant maintenance period.

D. Maintain the landscape to ensure water use efficiency.

E. Submit a regular maintenance schedule with the Certificate of Completion. The regular maintenance schedule shall include, but not be limited to, routine inspection; adjustment and repair of the irrigation system and its components; aerating and dethatching turf areas; replenishing mulch; fertilizing; pruning; weeding in all landscape areas, and removing and obstruction to emission devices. Operation of the irrigation system outside the normal watering window is allowed for auditing and system maintenance.

F. Repair of irrigation equipment shall be done with the originally installed components or their equivalents.

G. Implement sustainable or environmentally-friendly practices for landscape maintenance.

3.12 IRRIGATION SCHEDULE

A. Program the controller for the plant establishment period and the one 12-month irrigation schedule. Program and adjust controller to apply water as required for healthy plant growth, maintenance and water conservation.

A. For the efficient use of water, prepare manage, and evaluate irrigation schedule to utilize the minimum amount of water required to establish and maintain plant health and meet the following criteria:
   1. Irrigation scheduling shall be regulated by automatic irrigation controllers.
   2. Overhead irrigation shall be scheduled between 10:00 p.m. and 6:00 a.m. unless weather conditions prevent it. Operation of the irrigation system outside the normal watering window is allowed for auditing and system maintenance.
   3. For implementation of the irrigation schedule, particular attention must be paid to irrigation run times, emission device, flow rate, and current reference evapotranspiration, so that applied water meets the Estimated Total Water Use. Total annual applied water shall be less than or equal to Maximum Applied Water Allowance (MAWA). Actual irrigation schedules shall be regulated by automatic irrigation controllers using current reference evapotranspiration data (e.g., CIMIS) or soil moisture sensor data.
   4. Program the controller to operate automatically based on Evapotranspiration (ET) data ET.
   5. Parameters used to set the automatic controller shall be developed and submitted for each of the following
      a. The plant establishment period;
      b. The established landscape; and
      c. Temporarily irrigated areas.
   6. Each irrigation schedule shall consider for each station all of the following that apply:
      a. Irrigation interval (days between irrigation);
      b. Irrigation run times (hours or minutes per irrigation event to avoid runoff);
      c. Number of cycle starts required for each irrigation event to avoid runoff;
      d. Amount of applied water scheduled to be applied on a monthly basis;
      e. Application rate setting;
      f. Root depth setting;
      g. Plant type setting;
      h. Soil type;
      i. Slope factor setting;
      j. Shade factor setting; and
      k. Irrigation uniformity or efficiency setting.

3.13 REVIEWS PRIOR TO ACCEPTANCE

A. Notify the Owner’s Representative in advance for the following reviews, according to the time indicated:
   1. Pre-construction conference - 7 days.
   2. Supply line pressure test and control wire installation - 72 hours.
   3. Coverage and controller test - 72 hours.
   4. Final inspection - 7 days.
   5. Make correction and adjustments as required to provide the following minimum Distribution Uniformity:
      a. Rotary head irrigation: 70%
      b. Spray head irrigation: 62.5%

B. No reviews will commence without record drawings, without completing previously noted corrections, or without preparing the system for review.

C. Submit the signed Certificate of Completion and the following as part of the Maintenance and Operations Manual specified:
   1. Submit the signed Certificate of Completion
   2. Record drawings
   3. Irrigation scheduling parameters used to set the controller
   4. Irrigation controller schedule
   5. Landscape maintenance schedule
   6. Soil analysis report and documentation verifying implementation of soil preparation
   7. Letter of certification from controller manufacturer's representative certifying the controller is properly programmed for ET operation.
   8. Written verification of static and dynamic water pressure.
   9. Irrigation Audit Report.

C**ertificate of Completion**
This certificate is filled out by the project applicant, landscape architect and landscape contractor upon completion of the landscape project.

Part 1. Project Information Sheet

Date	MMWD Project Number
Project Name	Project Address
Name of Project Applicant	Telephone Number
	Fax Number (
Title	Email Address
Company	

"I/we certify that I/we have received copies of all the documents within Landscape Documentation Package and that it is our responsibility to see that the project is maintained in accordance with the Landscape and Irrigation Maintenance Schedule."

Property Owner Signature Date

Part 2. Landscape Architect and/or Landscape Contractor/Installer

Landscape Architect Name	Telephone Number

Title	Fax Number
License Number	
Carducci & Associates	555 Beach Street, 4th Floor San Francisco, CA 94133

Landscape Contractor Name	Telephone Number
Title	Fax Number
License Number	Email Address
Company	Street Address

"I/we certify that the work has been completed in accordance with the ordinance and that the landscape planting and irrigation installation conform to the criteria and specifications of the approved Landscape Documentation Package. Additionally, a landscape audit and irrigation maintenance schedule have been completed and are attached to this certificate showing that the system meets the efficiency requirements used in the Maximum Applied Water Allowance calculation".

Landscape Architect Signature Date

Landscape Contractor Signature Date

3.14 FINAL REVIEW AND CLEANUP:

A. Operate each system in its entirety for the Owner's Representative at time of final review. Any items deemed not acceptable by the Owner's Representative shall be reworked to the complete satisfaction of the Owner Representative.

B. Provide evidence to the Owner's Representative that the Owner has received all accessories and equipment as required before final review can occur.

C. Final acceptance and start of warranty period will occur no later than the end of the plant maintenance period.

D. For time of final review, Contractor shall arrange a meeting with the Owner's maintenance personnel to demonstrate the operation of the irrigation systems automatically in order to verify acceptance and to familiarize the maintenance personnel with the system and recommended programming.

E. All work shall be left in a condition satisfactory to the Owner Representative.

3.15 CLOSEOUT

A. Operate each system in its entirety for the Inspector at time of final review. Any items deemed not acceptable by the Inspector shall be reworked to the complete satisfaction of the Inspector.

B. Provide evidence to the Inspector that the Owner has received all accessories and equipment as required before final review can occur.

C. Final acceptance and start of warranty period will occur no later than the end of the plant maintenance period.

D. Include copies of the material submittals and manufactured material suppliers and installers name and telephone number and the items required as part of the Certificate of Completion in the Operations and Maintenance manuals as part of the closeout documents.

E. Include warranty and manufacturer's warranty information of specified items with warranties.

END OF SECTION 32 80 00

SECTION 32 85 00 - LANDSCAPE DRAINAGE

PART 1 GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials and equipment for installation of the landscape drainage systems as indicated on the drawings.

B. Related work specified elsewhere includes:

1. Section 31 00 00, Earthwork
2. Section 32 13 00, Concrete
3. Section 32 80 00, Irrigation
4. Section 32 90 00, Planting
5. Section 33 41 00, Storm Drainage

1.2 REFERENCE AND STANDARDS

A. Qualifications: All Landscape Drainage sub-contractors bidding on this project must have a California license and be experienced in the installation, in Northern California, of landscapes for at least 5 years and have completed five (5) projects in Northern California of comparable size, type and complexity, in the past three (3) years.

B. Perform work in accordance with all applicable laws, codes and regulations required by the State Water Resources Control Board and local City and County.

C. Reference to "Standard Specifications" shall mean the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.

D. When the Specifications call for materials and construction of a better quality or larger sizes than required by the ordinances, the provisions of the Specifications shall take precedence over the requirements of said ordinances.

E. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557 laboratory compaction procedure.

F. Construction Safety Orders of the State of California.

G. Trench Safety Provision, Section 6705, California Labor Code.

1.3 SOILS REPORT

A. A soil investigation report has been prepared for the project.

B. The report is available in the office of the Architect and the Construction Manager for inspection by the Contractor. Unless otherwise specified, it is intended that all work be performed in accordance with the provisions of the report.

C. Drilled piers may encounter ground water. Excavations for drilled piers may require casings and installation of concrete by means of pumping under the direction of the Geotechnical Engineer.

1.4 SOILS BORINGS

A. Subsurface soils investigations have been made at the site and logs of the test holes are available with the Soils Report. Such investigations have been made for the purposes of design only, and neither the Landscape Architect, the Owner, nor the Soils Engineers guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations

1.5 PROJECT CONDITIONS

A. Before proceeding with work, field verify the materials, sizes and elevations of existing storm drainage facilities to remain and be connected to.

B. Before proceeding with work, clean and flush the existing storm drainage facilities to remain and be connected to within the limit of work.

C Protect excavations by shoring, bracing, sheeting, underpinning, or other methods as required to prevent cave-ins or loose dirt from entering excavations. Barricade open excavations and post warning lights at work adjacent to public streets and walks.

D. Underpin adjacent structure(s), including utility service lines, which may be damaged by excavation operations.

E. Promptly repair damage to adjacent facilities caused by earthwork operations. Cost of repair at Contractor's expense.

F. Promptly notify the Inspector of unexpected subsurface conditions.

G. Trench Excavations and Sidewall Support: Trenching, both in fill soils and residual soil and weathered rock, can be performed using standard rubber-tire or track-mounted backhoes or excavators. Trenching to depths greater than 4.5 feet will require trench shields or shoring per OSHA regulations. Trenches or excavations around manholes or in areas that cannot be easily shored may require laying slopes back per OSHA recommendations and procedures. In areas beneath paved parking lots, trenches with saw-cut pavement on flat ground would provide the most stable conditions with respect to possible trench wall caving or sloughing. Trenches dug parallel to slopes will be the least stable.

H. Trench Stabilization and Dewatering Considerations: In instances where excessive caving or unstable wall conditions are encountered, the Geotechnical Engineer may recommend that trench shields be used both for worker safety and to maintain integrity of the trench. Minimizing the length of trench open at one time will also minimize trench instability. If there is a significant risk of side wall sloughing and bottom heaving, the Geotechnical Engineer may recommend that a crushed rock-working surface be placed. This working surface shall be built by over excavating the soil beneath the trench at least 12-inches, shoring established, then replacing with at least 12-inches of 1-1/2-inch maximum, crush rock (3/4-inch by ¼-inch would be ideal). The crushed rock shall be underlain with filter fabric (MIRAFI 140N or equal). Also, for this condition, the Geotechnical Engineer recommends the need to keep trenches open as short a time as if possible before backfilling. The risk of trench wall squeezing and bottom heave increases with time.

1.6 GENERAL REQUIREMENTS

A. Sheeting and Shoring: Furnish, place and maintain such sheeting, bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen, to facilitate the work, and to prevent damage to the pipes and structures or facilities. Upon completion of the work, all bracing and shoring shall be removed, unless otherwise directed by the Inspector.

B. Protection of Other Property: Excavation and other work over, under and adjacent to existing pipelines, cables, conduit runs or structures of any kind shall be procured in such a manner as not to interfere with the safe operation and use of such installations. Should any damage be incurred to existing facilities during the Contractor's operations, the Contractor shall immediately notify the Owner's Representative and authorities, and shall arrange for the immediate repair of same at his own expense.

C. Underground Obstruction: The locations of existing underground utilities and structures, insofar as they are known from information furnished by the respective utility companies and agencies, have been shown on the drawings. The Owner assumes no responsibility for the accuracy or completeness of said data, which is offered solely for the convenience of the Contractor.

D. Control of Water: Take measures as may be required and furnish, install and operate such pumps or other devices as may be necessary to remove any seepage, storm water or sewage that may be found or may accumulate in the excavations during the progress of the work. Keep excavations entirely free from water at all times during the construction of the work, and until the Geotechnical Engineer gives permission to cease pumping.

E. Pavement Restoration: Pavement, bases and compacted subgrade disturbed by trenching operations shall be replaced in an acceptable manner with materials equal to the adjacent compacted subgrade, bases and pavement for a minimum distance of 12" on each side of the trench, and shall conform to the requirements of these Specifications or to local ordinances governing such replacement.

1.7 COORDINATION

A. Examine the site and familiarize all conditions.

B. Coordinate this work with the work of other Sections to avoid delay and interference with other work.

C. Layout of equipment, accessories and piping system is generally diagrammatic, unless specifically dimensioned. Drawings and details shall be checked for interferences before installing the work. The right is reserved to make any reasonable change in location of piping shown on the drawings without increase in Contract price.

D. Keep an accurate dimensioned record of as-built location and depth, as referred to accepted based datum, on all lines, drop inlets, etc. Keep record drawings up-to-date as the job progresses and available for inspection. Prior to final acceptance and approval of the work, deliver a copy of this record to the Inspector in neat and legible form.

1.8 SUBMITTALS

A. Comply with General Conditions.

B. Product Literature:
1. Pipe & fittings.
2. Cleanouts.
3. Filter fabric.
4. Drain inlets.

C. Certificate of Letter of Compliance:

1. Sand backfill with sieve analysis.
2. Permeable backfill.
3. Certified copies of test reports demonstrating conformance to applicable pipe specifications prior to installation of any pipe.

D. Samples:
1. Filter fabric.
2. Sand backfill.
3. Permeable backfill.

1.9 FIELD QUALITY CONTROL

A. Contractor shall provide adequate notice, cooperate with, provide access to the work, and assist testing agency and their representatives in execution of their function.

B. When, during the progress of work, field tests indicate that installed compacted materials do not meet specified requirements, provide additional compaction until specified density is achieved, or remove and replace defective materials with new materials as directed by the Inspector. Cost of additional labor, materials, and testing to attain specified density at Contractor's expense.

C. The Contractor shall engage a California Registered Civil Engineer or licensed Land Surveyor to perform field engineering.

D. The Contractor shall engage a California Registered Civil Engineer or licensed Land Surveyor to perform a conformance survey at completion of storm drainage.

E. The Contractor shall engage a California Registered Civil Engineer or licensed Land Surveyor to perform a conformance survey at completion of the project and provide a hard copy of the survey and an AutoCAD copy of the survey as part of the closeout documents.

PART 2 MATERIALS

2.1 STORM DRAINAGE PIPE

A. Corrugated High Density Polyethylene (CHDPE) may be substituted for Polyvinyl Chloride (PVC) Pipe where PVC pipe is noted on the drawings.

B. Polyvinyl Chloride (PVC) Pipe: PVC pipe and fittings shall meet the extra strength minimum of SDR-35 of the requirements of ASTM Specification D3034. Joints shall be rubber ring for Storm Drainage Pipe. Manufactured by J-M Manufacturing, Stockton, CA, (1-800-621-4404), or accepted equal.
1. PVC Smooth Wall Perforated Drain Pipe: Size as noted on the drawings, and manufactured to meet CALTRANS Standard Specification Section 68 and AASHTO M278, or accepted equal. Color, White.
2. Storm Drain Pipe: SDR-35. Size as noted on the drawings and manufactured to meet Caltrans standard specifications. Color, White.

C. Corrugated High Density Polyethylene (CHDPE) Storm Drain Pipe: CHDPE solid wall pipe and fittings shall be N-12 drainage pipe with N-12 IB WT pipe joint assembly as manufactured by Advanced Drainage Systems, 800-821-6710. Inc., or accepted equal. Local sales representative: Jim Winslow, 510-913-2211.

D. Corrugated High Density Polyethylene (CHDPE) Perforated Drain Pipe: Perforated CHDPE pipe and fittings shall be N-12 Series 65 WT Corrugated HDPE Pipe and fittings as

manufactured by Advanced Drainage Systems, 800-821-6710. Inc., or accepted equal. Local sales representative: Jim Winslow, 510-913-2211.

2.2 DRAIN INLETS, CLEAN OUTS & AREA DRAINS

A. As noted on Drawings:

B. Planter Drain Clean Out: As detailed and NDS 13S when flush with finish grade.

2.3 PERMEABLE BACKFILL (Drain Rock)

A. All permeable backfill used in subsurface drain installations must come from one supplier only.

B. Virgin, angular ¾-inch crushed rock material and shall be clean, free draining, crushed rock meeting the following requirements:

1. Particle Size Distribution:

Percent Passing	Sieve Designation
100	1”
25-80	¾”
0-30	3/8”
0-15	#4
0-5	#8
0-3	#200

2. Durability Index >40.

2.4 ANGULAR WASHED SAND

A. Sand backfill and sand for top dressing shall be medium coarse washed USGA Sand and meet or exceed recommended values:

B. A total silt and clay of no more than 4%.

C. Shall be naturally angled sand. No rounded silica sand.

D. Sand shall meet or exceed the following values of USGA sand particle distribution:

Sieve Size	USGA Spec - Individual Percent Retained
#4	0
#10	0-3%
#18	0-7%
#35	Minimum 60% Combined
#60	
#100	20% Maximum
#270	5% Maximum

E. Sand shall be from one of the following sources or approved equal:
1. Top Dressing Sand available from Brown Sand Inc. 209-234-1200.
2. G8 Sand available from TMT Enterprises 408-432-9040-Matt.

2.5 IMPORTED BACKFILL

A. Import backfill, where required, shall meet the requirements of Fill in Section 31 000 Earthwork.

B. Planting soil, where required, shall meet the requirements of topsoil in Section 32 9000 Planting.

2.6 FILTER FABRIC

A. Polypropylene non-woven filter fabric with uniform fiber distribution by "Mirafi, Inc." #140N, or accepted equal.

2.7 PIPE BEDDING (SAND BEDDING)

A. Pipe bedding material shall consist of permeable material where called for on drawings.

B. Pipe bedding material where not required to be permeable material shall consist of sand or granular materials naturally produced by the disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay and other deleterious substances with 90 to 100 percent of particles passing the No. 4 sieve and no more than of 5 percent finer than the No. 200 sieve. The bedding shall be at 3 to 6 inches below the pipe and 12 inches above the pipe.

2.8 TRENCH BACKFILL

A. Trench backfill shall consist of permeable material where called for on drawings.

B. Intermediate backfill (above the bedding material and below any pavement section) where not required to be permeable material may consist of on-site soils, provided the material has no organic material, no rocks larger than 3 inches, have a liquid limit equal to or less than 40, and a plasticity index equal to or less than 15 and is moisture conditioned and placed in thin lifts and compacted to at least 95 percent in structural areas and engineered fills and 85 percent in non-structural areas.

C. Trenches shall not be backfilled with pea gravel or crushed rock, except as a part of bedding material.

D. All the underground utility trenches located in paving, expect subsurface drains, shall be backfilled with native material or base rock or quarry fines or cement slurry all the way up to the required subgrade elevation. The material shall be placed in (12) inch un-compacted lifts and each lift shall be compacted to minimum of 95% relative compaction. The material shall be moisture conditioned properly, prior to placement in the trenches.

E. Trenches shall not be backfilled with pea gravel or crushed rock, except as a part of bedding material and no jetting will be allowed / permitted at any time during the backfill of the material. If trenches are deeper than five (5) feet, shoring is required and shall be installed in accordance with O.S.H.A. regulations

2.9 DRAINAGE MEMBRANE

A. J-Drain 400, Enkadrain 3811R or approved equal.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Lay storm drains true to line and grade by accurate and accepted methods, beginning at the outlet and proceeding upgrade. Storm lines shall slope uniformly between elevations given.

B. Pipe, fittings, precast sections, drain inlets, trench drains, clean outs, frames and covers shall be carefully handled at all times.

C. No pipe shall be laid which is cracked, checked, spalled or damaged. All damaged, cracked, checked or spalled sections shall be removed from the site.

D. Chain slings are not permitted. Support pipe loaded on trucks or stacked one upon another with wooden blocking. Pipe handled or skidways shall not be skidded or rolled against pipe already on the ground.

E. Install all pipes in the approximate locations shown and of size indicated on the drawings.

F. All pipeline and fittings shall be kept clean and closed during construction.

G. Install piping pitch down in direction of flow at minimum 0.5 percent, except where indicated otherwise.

H. Place bell ends of piping facing upstream. Install gasket seals, sleeves and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

3.2 TRENCH EXCAVATION

A. All utility trenches shall be excavated in accordance with current OSHA excavation and trench safety trench safety standards. The contractor shall be solely responsible for the design and construction of all excavation and trench safety.

B. The bottom of trenches shall be free of loose material at the bottom of the trenches compacted and tested by the assigned Field Engineer to a minimum of 95% relative compaction, prior to placement of the liner or pipes in the trenches.

C. Storm drain line bedding material shall consist of specified bedding. The bedding shall extend from the bottom of the trench to 1-foot above the top of the pipe. Sand bedding shall be placed in a trench free of standing water, and mechanically compacted to a dense condition (as verified by the Geotechnical Engineer).

D. Trench backfill above the pipe bedding shall meet the criteria for fill in Section 31 0000, Earthwork. The Geotechnical Engineer shall evaluate any proposed imported soil sample prior to it use as trench backfill. Trench backfill shall be placed in uniform layers not exceeding 8-inches in loose thickness, moisture-conditioned to near-optimum moisture content, and compacted. Backfill shall be compacted to at least 95 percent relative compaction in paved, structural areas and engineered fills and 85 percent in planted areas. Jetting shall not be permitted for any backfill compaction.

E. Any groundwater infiltrating into utility trenches shall be pumped out prior to backfilling.

F. Unless otherwise shown on the drawings, the width of trenches at any point below the top of the pipe shall not be greater than the outside diameter of the pipe plus 16" for pipe diameters 33" or less. Sheeting and bracing, where required, shall be placed within the trench width.

G. Do not over-excavate. Remove stones necessary to avoid point bearing. Pipes shall be bedded in accordance with backfill herein, and additionally where rock, hardpan or other unyielding foundation material is encountered in trenches at the grade or the bottom of the pipe. The hard unyielding material shall be excavated to a minimum depth of 6" below the bottom of the pipe bell or coupling, and such overdepths shall be backfilled with materials specified, for backfill and for backfilling the lower portion of trenches, compacted to a relative compaction of not less than 90%.

H. Unsatisfactory material such as mud, quicksand or other unsuitable materials encountered below the grades shown or specified which are directed or specified to be removed shall be replaced with selected materials, compacted to a relative compaction of not less than 90%.

I. In the event of excavation exceeding the trench width specified, furnish higher strength pipe or other construction methods (i.e., improved bedding), as accepted by the Inspector, to provide for the resultant increased loading. The Geotechnical Engineer shall have the right to limit the amount of trench that is opened or partially opened at any one time, and to limit the amount of trench left without backfill at any one time.

J. All materials, regardless of character and subsurface condition, shall be excavated to the depths indicated or specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins, or shall be separately stockpiled as required. Dispose of excess excavated material or unsalvageable material off of the property.

3.3 EXCAVATION FOR STRUCTURES AND APPURTENANCES

A. Excavation for inlets and similar structures shall be sufficient to provide at least 12" in the clear between the outer surfaces and the adjacent earth or timber that may be used to hold and protect the banks. Any overdepth excavation below such appurtenances that has not been directed will be considered unauthorized and shall be refilled with sand, selected materials, gravel or concrete, as directed and at the expense of the Contractor. Unsatisfactory material such as mud, quicksand or other unsuitable materials encountered below the grades shown or specified for structure foundations, when directed shall be removed and replaced as specified in Trench Excavation above.

3.4 DRAIN INLETS

A. Install plumb, level and square to adjacent structure or paving or as otherwise directed by Inspector.

B. Place mortar to slope bottom of inlet 1/4"/ft. for drain inlets.

C. Bolt grate to concrete drain box or secure with a chain to secure grate from vandals and allow for maintenance access; length as required. Anchor chain in concrete and fasten to grate as accepted. Submit sample.

D. Connect Drop Inlet directly to storm drainpipe and make a complete watertight connection.

3.5 SAND BACKFILL (PIPE BEDDING)

A. Pipe shall have sand bedding in accordance with the requirements specified herein.

B. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The bedding shall be at 3 to 6 inches below the pipe and 12 inches above the pipe.

C. Bedding shall be placed and compacted in thin lifts (8-inch maximum loose thickness) and compacted in-place.

3.6 SUBSURFACE DRAINS

A. Install subsurface drains where indicated on the drawings and backfill with permeable material as specified. Provide not less than 3" of permeable material under pipe. Bell and spigot, and tongue and groove concrete pipe shall be laid without mortar in the joints, and lengths shall be pressed firmly together to prevent infiltration of fine material. Lay all pipe perforations down. Where subsurface drains connect to storm drainage systems, verify inverts of connections and lay pipe accordingly to drain.

3.7 DITCHES AND SWALES

A. Construct ditches and swales as detailed and in the areas designated to convey storm water to the storm drainage facilities.

3.8 BACKFILLING

A. Do not backfill trenches until all required tests are performed and inspections made. Remove sheeting, bracing and shoring. Backfill trench with selected material suitable for the specified compaction. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified.

B. Compact granular material bedding by mechanical tampers to the specified relative compaction. Bedding and backfill materials as applicable shall be carefully compacted below the spring line of the pipe, and shall be brought up simultaneously on both sides to the full specified depth so as to obviate any displacement of the pipe from its true alignment. Special care shall be taken not to damage the coating or wrapping of pipes.

C. Backfilling for Structures: Backfill material, placement and compaction for manholes and similar structures shall conform to the requirements stipulated above for the trench using 6” - 8" uniform layers.

3.9 RELATIVE COMPACTION

A. Each layer of bedding material and backfill over and around pipes, and each layer of backfill around and adjacent to structures, shall be compacted at the proper moisture content to 95% relative compaction.

B. Allow sufficient time to perform the necessary testing to assure that the backfill is being properly compacted. Backfill operations shall be scheduled in such manner as to permit making necessary control tests for each backfill lift prior to the placing of subsequent lifts. Field density tests will be performed in sufficient number to ensure that the specified density is being obtained.

3.10 DAMAGE BY LEAKS

A. The Contractor shall be responsible for all damage to any part of the premises caused by leaks or breaks in pipes, connections or appurtenances furnished and installed under this Specification for a period of one (1) year after date of acceptance of the project by the Owner.

3.11 CLOSING OF UNINSPECTED WORK

A. Do not allow any of the work installed to be covered up or enclosed before it has been inspected and accepted by the Inspector. Any work enclosed or covered before it has been accepted or directed to be covered shall be uncovered by the Contractor, at his expense, and replaced as directed.

3.12 FIELD QUALITY CONTROL

A. Per General Conditions.

B. Request inspection prior to and immediately after placing cover over pipe.

C. Compaction testing will be performed in accordance with the Standard Specifications.

D. Exfiltration Test, Deflection Test, and Pressure Test: Test in accordance with Standard Specifications.

E. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.13 CARE AND CLEANING: Per General Conditions

A. During construction, protect work from damage by accident, staining or otherwise. Upon completion, repair or replace broken, damaged or defective parts. All work shall be left in a condition satisfactory to the Owner. Remove all surplus materials and debris from the premises.
B. At completion, flush and clean out installed piping systems.

3.14 IDENTIFICATION

A. Underground Type Plastic Line Makers: The manufacturer's standard permanent, bright colored, continuous plastic tape intended for direct-burial services not less than 6-inches wide x 4-mils thick. Provide green tape with black printing reading "CAUTION STORM DRAIN LINE BURIED BELOW".

B. Tape markers shall be of detection type with foil backing.

C. Install continuous plastic underground warming tape during back-filling of trench. Locate 12" directly above piping.

3.15 DRAINAGE MEMBRANE

A. Install at back of planter walls as shown on Drawings and according to Manufacturer's specifications.

3.16 CLOSEOUT

A. Before project acceptance demonstrate that installed piping system is flushed and clean.

B. The Contractor shall engage a California Registered Civil Engineer or licensed Land Surveyor to perform a conformance survey at completion of the project and provide a hard copy of the survey and an AutoCAD copy of the survey as part of the closeout documents.

C. Demonstrate to the Owner's personnel where the drains and perimeter drain cleanouts are located and how to open and clean them.

D. Mark the location s of the perimeter drain cleanouts on adjacent concrete surface.

E. Include copies of the storm drain material submittals in the Operations and Maintenance manuals as part of the closeout documents.

END OF SECTION 32 85 00

SECTION 32 90 00 - PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide planting work, erosion control and planting maintenance complete as shown on the drawings and as specified.

B. Related work specified elsewhere includes:

1. Section 12 93 00, Site Furnishings
2. Section 31 00 00, Earthwork
3. Section 32 13 13, Landscape Concrete
4. Section 32 80 00, Irrigation
5. Section 33 40 10, Storm Drainage

1.2 QUALITY ASSURANCE

A. Reference Standards:

1. Manufacturer's recommendations.
2. "Sunset Western Garden Book," Lane Publishing Co., Menlo Park, California; current edition.
3. "American Standards for Nursery Stock," American Association of Nurseryman, 230 Southern Building, Washington, D.C. 20005.
4. A soil investigation report has been prepared for the project. The report is available in the office of the Architect and the Construction Manager for inspection by the Contractor. Unless otherwise specified, it is intended that all work be performed in accordance with the provisions of the report. Drilled piers may encounter ground water. Excavations for drilled piers may require casings and installation of concrete by means of pumping under the direction of the Geotechnical Engineer.
5. Weed Control Methods Handbook, The Nature Conservancy, Tu, M., Hurd, C. & J.M. Randall. 2001. http://tncweeds.ucdavis.edu.

B. Qualifications:

1. Experience: Assign a full-time employee to the job as foreman for the duration of the Contract with a certified landscape technician, certification through CLCA or minimum of four (4) years experience in landscape installation and maintenance supervision, with experience or training in turf management, entomology, pest control, soils, fertilizers and plant identification.

2. Labor Force: Provide a landscape installation and maintenance force thoroughly familiar with, and trained in, the work to be accomplished to perform the task in a competent, efficient manner acceptable to the Owner.

C. Requirements:

1. Supervision: The foreman shall directly supervise the work force at all times and be present during the entire installation. Notify Project Inspector of all changes in supervision.

2. Identification: Provide proper identification at all times for landscape maintenance firm's vehicles and a labor force uniformly dressed in a manner satisfactory to Project Inspector.

D. Plant Material Standards:

1. Quality and Size of Plants: Conform to the State of California Grading Code of Nursery Stock, No. 1 grade. Use only nursery-grown stock, which is free from insect pests and diseases.

2. Comply with federal and state laws requiring inspection for plant diseases and infestations. Submit inspection certificates required by law with each shipment of plants, and deliver certificates to the Owner. Obtain clearance from the County Agricultural Commissioner as required by law, before planting plants delivered from outside the County in which planted.

E. Testing Agency: Soil and Plant Laboratory, Inc. 1101 S. Winchester Blvd. Suite G-17, San Jose, CA 95128; Tel. (408) 727-0330.

1.3 SUBMITTALS, per General Requirements

A. Product Data: Manufacturer's current catalog cuts and specifications of the following:

1. Fertilizers

2. Soil Amendment

3. Mulch

4. Sod

5. Tree ties and stakes

6. Mycorrhiza

7. Sod maintenance instructions from the sod grower.

8. Cardboard, for sheet mulching

B. Samples:

1. Organic Mulch: Submit two 1-pint samples.

2. Import Sandy Loam topsoil: Submit two 1-pint samples.

3. Import Biofiltration soil: Submit two 1-pint samples.

4. Sod: Submit sample.

5. Plants: Submit crop photos of trees, shrubs, perennials, and groundcover plants.

C. Certificates of Compliance for the following:

1. Soil amendment, chemical and physical properties.

2. Quantity of soil amendment required for soil preparation.

3. Receipts for quantity of soil amendment delivered for soil preparation.

4. Import Biofiltration soil.

5. Within 30 days of Notice to Proceed, provide a letter from the contactor certifying that all plant materials are available.

D. Topsoil Analysis: After acceptance of rough grading and topsoil placement, obtain two samples of topsoil and submit to Soil and Plant Laboratory, Inc for "horticultural suitability" analysis report and MWELO recommendations, including evaluation of physical and chemical properties of soil and recommendations for adding amendment and fertilizers to the soil.

Upon acceptance of the Laboratory's report by the Landscape Architect, the recommendations in the report shall become a part of the Specifications and the quantities of soil amendment; fertilizer and other additives shall be adjusted to conform with the report. Request Testing Laboratory to send one copy of test results directly to Landscape Architect and one copy to the Owner.

E. Substitutions:

1. If the Contractor desires to substitute a product, he shall list each item and note it as a "substitution" and provide the following information:

a. Descriptive information describing its similarities to the specified product.

b. Reason Contractor wants the substitution.

c. The price difference in the two different products.

2. If the product is accepted and, in the opinion of the Landscape Architect, the substituted product does not perform as well as it should, the Contractor shall replace it with the specified product at no additional cost to the Owner.

1.4 PROJECT/SITE CONDITIONS

A. Site Visit: At beginning of work, visit and walk the site with the Project Inspector to clarify scope of work and understand existing project/site conditions.

1.5 WARRANTY AND REPLACEMENT

A. Pre-Emergence Weed Killer: Warrant the work against weed growth for a period of four (4) months after application.

B. Warrant all plants and planting to be in a healthy, thriving condition until the end of the maintenance period, and deciduous plants beyond that time until active growth is evident.

C. Replace all dead plants and plants not in a vigorous condition immediately as directed by the Project Inspector at Contractor's expense. Install replacement plants before the final acceptance at the size specified.

D. Warrant all plant material for a period of one year after final acceptance of the maintenance work against defects in the plant prior to installation.

E. Warrant plant installation and maintenance by Contractor against defects for a period of one year.

PART 2 - PRODUCTS

2.1 PLANTS

A. Plant the variety, quantity and size indicated. The total quantity tabulated are considered approximate and furnished for convenience only.

B. Tag plants of the type or name indicated and in accordance with the standard practice recommended by the American Association of Nurserymen.

C. Install healthy, shapely and well-rooted plants with no evidence of having been rootbound, restricted or deformed.

D. Take precautions to ensure that the plants will arrive at the site in proper condition for successful growth. Protect plants in transit from windburn and sunburn. Protect and maintain plants on site by proper storage and watering.

E. Trees: select straight trunks with the leader intact, undamaged and uncut with all old abrasions and cuts completely callused over. Do not prune plants prior to delivery.

F. Measure trees and shrubs with branches in normal position. Height and spread dimensions indicated refer to the main body of the plant, and not from branch tip to tip.

G. Substitutions will not be permitted, except as follows:

1. If proof is submitted to the Landscape Architect that any plant specified is not obtainable, a proposal will be considered for use of nearest equivalent size or variety with an equitable adjustment of contract price.

2. Substantiate and submit proof in writing to the Landscape Architect within 10 days after the effective date of Notice to Proceed.

2.2 FERTILIZERS

A. Commercial fertilizer, pelleted or granular form, conform to the requirements of Chapter 7, Article 2, of the Agricultural Code of the State of California for fertilizing materials as follows:

Type A: Slow release fertilizer: Lawn Restore Fertilizer, 10% Nitrogen, 2% Phosphoric Acid and 6% Potash (10-2-6) available from Peaceful Valley Farm Supply, Grass Valley, CA, www.groworganic.com, 888-784-1722 or approved equal

Type B: AgSafe 20-10-5, 21-gram Planting Tablets complete fertilizer 20% Nitrogen, 10% Phosphate and 5% Potash (20-10-5) slow-release plant food with minors, 10% humus, Mycorrhizae, plant extracts, and fish extracts for two year root zone feeding. Product P101 Grower & Landscaper Bulk Case (21g), 500 tablets (21g) per case, available from Agritab Corporation, Clearfield, UT, www.agritab.com, 800-398-3803.

Type C: AgSafe 20-10-5,10-gram Planting Tablets complete fertilizer 20% Nitrogen, 10% Phosphate and 5% Potash (20-10-5) slow-release plant food with minors, 10% humus, Mycorrhizae, plant extracts, and fish extracts for two year root zone feeding. Product P102 Grower & Landscaper Bulk Case (10g), 1,000 tablets (10g) per case, available from Agritab Corporation, Clearfield, UT, www.agritab.com 800-398-3803.

1. Iron Sulfate, 31% Fe
2. Potassium Sulfate (0-0-50)
3. Soil Sulfur: Tiger Organic 0-0-0-90 Sulfur
4. Agricultural Gypsum
5. Treble Superphosphate: 0-48-0

If commercial fertilizer having this analysis is not obtainable, other similar commercial fertilizer may be used providing it meets the acceptance of the Landscape Architect. Amend fertilizer submission as required by soil analysis requirements.

2.3 SOIL AMENDMENT

A. Approved Products: Super-Humus Compost. Available at BFI Organics, 1601 Dixon Landing Road, Milpitas, CA, 408-945-2836, “Wonder Grow” available from TMT Enterprises, 408-432-9040, Redi-Crop, 408-888-7632, or Lopez Ag Service Organic Compost, 916-682-5450, Al., with the following properties:

B. Reaction (pH): 5.5 to 8.0 as determined in saturated paste.

C. Screened to 1/4” minus and having the following graduation:

Percent Passing	Sieve Designation
85- 100	9.51mm (3/8")
50-80	2.38mm (No. 8)
0-40	500 micron (No. 35)

D. Soluble salts as determined by Saturation Extract Solution less than 10 mmhos/cm or ds/M.

E. Carbon to nitrogen ratio less than 35:1.

F. Organic content: Minimum of 50% base on dry weight and determined by ash method. Minimum of 250 lbs organic matter per cubic yard of compost.

G. Moisture Content: 35-60%.

H. Shall be free of glass, metal and visible plastics.

I. Odor shall be soil-like (musty or moldy) not sour, ammonia-like or putrid.

J. Characterization: identifiable wood pieces are acceptable but the balance of material should be soil-like without recognizable grass or leaves.

K. Color: Dark brown to black.

L. Submit sample to the Landscape Architect two weeks before accepted delivery of amendment to the project with laboratory organic amendment analysis report to include above information and iron content. Laboratory organic amendment analysis report is to be from a sample that is no older than one month old.

2.4 SHEET MULCH

A. Bark Mulch: Zanker Mahogany Mulch Mini, small, 1-inch maximum size in any direction, redwood color, or equivalent as accepted by the Landscape Architect. Available at Zanker Landscape Materials, 705 Los Esteros Road, San Jose CA, 408-586-9292.

B. Cardboard for sheet mulching: Clean, Recycled, B-flute cardboard rolls free of plastic or any non-biodegradable material. Available from Lyngso Garden Materials, San Carlos. (650) 364-1977. Contractor is encouraged to reuse any clean cardboard they have available that may be otherwise thrown away.

C. Submit one (1) sample of bark mulches to the Landscape Architect for acceptance within two weeks of award of Contract. Resubmit until acceptable to Owner, at no extra cost.

2.5 PLANT BACKFILL: Use a mixture of 2 parts soil from the hole, and 1 part amendment.

2.6 ON SITE TOPSOIL

A. Satisfactory topsoil shall be from top 6” of existing planting areas and free of subsoil, clay, lumps, stones and other objects over 1" in diameter, and without weeds, roots and other objectionable material.

B. Strip planting soil to whatever depths encountered, a minimum of six inches in a manner to prevent intermingling with the underlying subsoil or other objectionable material. Topsoil stripping is limited to area indicated on drawings.

C. Remove heavy growths of grass from areas before stripping.

D. Stockpile topsoil in storage piles in areas shown, or where designated by Owner. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust

E. Refer to Soil Preparation Plan.

F. If herbicide contamination is suspected, then a radish/ryegrass growth trial must be performed. Consult with Owner prior to decision to test or not.

2.7 IMPORT SOIL

A. Import Infiltration Soil (Biotreatment or Bioretention soil) for Filtration and Infiltration Areas as follows:

1. Imported Infiltration Soil shall be capable of sustaining healthy plant life and achieve a long-term, in-place infiltration rate of at least 5 to 10 inches per hour. Soil shall be free of subsoil, heavy or stiff clay, rocks, gravel, brush, roots, weeds, noxious seeds, sticks, trash, and other deleterious substances. Soil shall not be infested with nematodes or with other noxious animal life or toxic substances. Soil shall be an even texture. Soil shall not be taken from areas on which are growing any noxious weeds such as Morning Glory, Sorrel, or Bermuda grass.

2. Comply with the requirements of the regional biotreatment soil specifications, approved by the Regional Water Board on November 28, 2011. The soil specifications are included in Attachment L of the Municipal Regional Stormwater Permit (MRP) [NPDES No. CAS612008, Order No. R2-2009-0074,] as amended. Effective December 1, 2011, stormwater biotreatment measures are required to use the Water Board-approved specifications. Alternative biotreatment mixes that achieve a long-term infiltration rate of 5 to 10 inches per hour, and are suitable for plant health, may be used in accordance with the requirements described in the specifications, under the heading “Verification of Alternative Bioretention Soil Mixes”.

3. Engineered soil meeting the requirements of Attachment L of the Municipal Regional Stormwater Permit may be available from local suppliers. Listing does not imply or guarantee that the mix as designed or delivered meets all requirements of Attachment L. Contractors and construction inspectors should independently obtain and review the required information before approving installation of a ‘brand-name’ soil mix from:

a. American Soil Products, San Rafael and Richmond, CA, Giacomo Damonte, 510-292-3018, or 510-292-3000, giacomo@americansoil.com.

b. TMT Enterprises, Inc., San Jose, CA, Matt Moore, 408-432-9040, matt@tmtenterprises.net.

c. LH Voss, Concord, CA, Bob Hawkins or Butch Voss, 800-660-8677 x 108 or 800-660-8677 x 109.

d. Contra Costa Topsoil, Martinez, CA, 925-228-4007.

e. Redi-Gro Corporation, Sacramento, CA, 916-381-6063.

4. Bioretention soils shall meet the following criteria:

a. Achieve a long-term, in-place infiltration rate of 5 inches to 10 per hour.

b. Support vigorous plant growth.

c. Consist of the following mixture of fine sand and compost, measured on a volume basis:

60%-70% Sand
30%-40% Compost

d. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be non-plastic. Sand meets ASTM C33 specifications for Fine Sand:

Percent Passing by Weight ASTM C33 Sand

Sieve Size	Minimum	Maximum
3/8 Inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40	5	55
No. 100	0	15
No. 200	0	5

e. Compost meets the following specifications:

(1) Feedstock materials are comprised of landscape/yard trimmings, grass clippings and food scrap waste.

(2) Organic Matter Content: 35 - 75% on a dry weight basis

(3) Carbon to Nitrogen Ratio: C:N < 25:1 and C:N >15:1

(4) Maturity/Stability: Compost is dark brown and has a soil-like odor. No recognizable grass or leaves visible. Any one of the following is required to indicate stability:

(i) Oxygen Test < 1.3 O2 /unit TS /hr

(ii) Specific oxy. Test < 1.5 O2 / unit BVS /

(iii) Respiration test < 8 C / unit VS / day

(iv) Dewar test < 20 Temp. rise (°C) e.

(v) Solvita® > 5 Index value

(5) Toxicity: Any one of the following measures is sufficient to indicate non-toxicity.

(i) NH4- : NO3-N < 3

(ii) Ammonium < 500 ppm, dry basis

(iii) Seed Germination > 80 % of control

(iv) Plant Trials > 80% of control

(v) Solvita® > 5 Index value

(6) Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.

(i) Total Nitrogen content 0.9% or above preferred.

(ii) Boron: Total <80 ppm; Soluble shall be <2.5 ppm

(7) Salinity: Must be reported; < 6.0 mmhos/cm

(8) pH: between 6.5 and 8.

(9) Compost Soil Texture: Percent Passing by Weight Compost

Sieve Size	Minimum	Maximum
1 Inch	99	100
1/2 Inch	90	100
1/4 Inch	40	90
No. 200	2	10

(10) Bulk Density: between 500 and 1100 dry pounds/cubic yard.

(11) Moisture Content: between 30% - 55% of dry solids.

(12) Inerts: relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume.

(13) Select Pathogens: Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram.

(14) Trace Contaminants Metals (Lead, Mercury, Etc.) – Product must meet US EPA, 40 CFR 503 regulations.

(15) Compost Testing – The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The compost supplier shall pay for the test.

5. Submittal Requirements: submit for approval:

a. A sample of mixed bioretention soil.

b. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this specification.

c. Grain size analysis results of the fine sand component performed in accordance with ASTM D422, Standard Test Method for Particle Size Analysis of Soils.

d. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards.

e. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, “Loss-On-Ignition Organic Matter Method”.

f. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.

g. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.

h. To ensure conformance, submit ½ gallon sample to Soil & Plant Laboratory for analytical packages: A06-2, A06-3, A05-1 or approved equal. Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site. Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

6. To ensure conformance, submit ½ gallon sample to Soil & Plant Laboratory for analytical packages: A06-2, A06-3, A05-1.

B. Imported Angular Washed Sand:

1. Refer to Section 33 40 10 Storm Drainage.

C. On-site topsoil as follows:

1. Planting soil is defined as on-site surface soil. Satisfactory planting soil shall be free of subsoil, clay, lumps, stones, and other objects over 1" in diameter, and without weeds, roots, and other objectionable material.

2. Strip planting soil to whatever depths encountered, a minimum of six inches in a manner to prevent intermingling with the underlying subsoil or other objectionable material. Topsoil stripping is limited to area indicated on drawings.

3. Remove heavy growths of grass from areas before stripping.

4. Stockpile topsoil in storage piles in areas shown, or where designated by Owner. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust.

5. If herbicide contamination is suspected then a radish/ryegrass growth trial must be performed. Consult with Landscape Architect prior to decision to test or not.

2.7 MYCORRHIZA

A. MycoApply® All Purpose Granular available from Mycorrhizal Applications, Inc www.mycorrhizae.com, PO Box 1181 Grants Pass, OR 97528, Telephone 866-476-7800, or 541.476.3985 fax, 541.476.1581

2.8 TREE SUPPORT POLES

A. As shown on Drawings.

2.9 TIES

A. Rubber strap, 32-inch minimum length without sharp edges adjacent to trunk, V.I.T. cinch-tie, or accepted equal.

2.10 GYPSUM: **Agricultural Gypsum**

2.11 PERMEABLE AGGREGATE MULCH

A. Permeable aggregate mulch to be virgin Class 2 permeable material in conformance to Section 68 "Subsurface Drains" of the CalTrans Standard Specifications, or accepted equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Verify that existing site conditions are as specified and indicated before beginning work under this section.

1. Grades: Inspect to verify grade of planting areas.

2. Damaged Earth: Inspect to verify that earth rendered unfit to receive planting due to concrete water, mortar, limewater or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the Owner's Representative.

B. Unsatisfactory Conditions: Report in writing to Owner’s Representative.

C. Acceptance: Beginning of installation means acceptance of existing conditions by installer.

D. Coordination: Coordinate with other trades for topsoil stripping and planting soil protection so that adequate, healthy, friable and acceptable topsoil is provided consistent with this section.

3.2 WEED REMOVAL

A. Inspect planting areas and remove and dispose of all invasive weeds, base rock and other foreign material, including soils contaminated with cement or other materials or debris, including the following invasive weeds. Request photographs of invasive weeds if required for identification. Refer to Weed Control Methods Handbook, The Nature Conservancy, Tu, M., Hurd, C. & J.M. Randall. 2001. http://tncweeds.ucdavis.edu.

Botanical Name	Common Name
TREES	
Acacia spp.	acacia

Ailanthus altissima	tree of heaven
Eucalyptus spp.	gum
Ficus carica	fig
Fraxinus uhdei	ash, evergreen
Juglans regia, Juglans californica var. hindsii	walnut, English or black
Myoporum laetum	Myoporum
Olea europaea	olive
Pinus radiata	Monterey pine
Platanus acerifolia	London plane tree
Populus nigra 'Italica'	Lombardy poplar
Prunus dulcis	almond
Prunus spp.	flowering plum, fruitful varieties
Quercus ilex	holly oak
Robinia pseudoacacia	black locust
Schinus spp.	pepper trees
Tamarix spp.	tamarisk, salt cedar
Ulmus spp.	elm
SHRUBS	
Acacia spp	acacia
Arundinaria, Chimonobambusa, Phyllostachys, etc.	bamboo, running types
Arundo donax	giant reed
Cortaderia selloana, C. jubata	pampas grass, jubata grass
Cotoneaster spp.	cotoneaster
Cytisus scoparius	broom, Scotch
Digitalis purpurea	foxglove
Genista monspessulana, previously Cytisus monspessulanus	broom, French
Ligustrum lucidum	glossy privet
Melissa officinalis	lemon balm
Pennisetum setaceum; purple variety "Cupreum" is sterile and acceptable	fountain grass
Pyracantha spp.	Pyracantha
Rubus discolor	Himalayan blackberry
Spartium junceum	broom, Spanish
Ulex europaea	gorse
GROUNDCOVERS, VINES	
Acacia spp	acacia
Arctotheca calendula	Cape weed
Carpobrotus edulis, C. chilensis, Mesembryanthemum spp.)	ice plants
Cotoneaster spp.	Cotoneaster
Delairea odorata, previously Senecio mikanioides	ivy, Cape
Hedera canariensis	ivy, Algerian
Hedera helix	ivy, English
Mentha spp.	mint, any kind including pennyroyal, peppermint, spearmint
Pennisetum clandestinum	kikuyu grass
Pyracantha spp.	Pyracantha

Source: Santa Clara Valley Water District, May 2001	
OTHERS (2007)	
Centaurea solstitialis	yellow star thistle
Conium maculatum	poison-hemlock
Cynodon dactylon	Bermuda grass
Echium Candicans (fastuosum)	pride-of-Madeira
Elaeagnus angustifolia.	Russian-olive
Foeniculum vulgare	fennel
Raphanus sativus	radish
Tropaeolum majus	garden nasturtium
Urtica Dioica	stinging nettle
Zantedeschia Aethiopica	calla lily

B. Clear the planting, seed and mulch bed areas within the limit of work of all objectionable plant material, to include roots, snags, brush, grass, weeds, and similar undesirable vegetation and any other debris found at the site not specified as improvements to be included as part of this project. All such materials shall be removed from the site and disposed of in an acceptable manner.

C. In addition to the clearing of vegetation growth, the area shall be grubbed to a depth of six inches (6") below finish grade of debris and rocks over one inch (1") in size. Said material shall be removed from the site and disposed of in an acceptable manner.

D. Prior to removal of any weeds from the site, the weeds shall receive an application of Roundup herbicide at a rate of 5 quarts minimum per acre. After application, allow 10-15 days before removing the dry from the site.

E. Dispose offsite, any site soils from areas on which are growing any noxious weeds such as Fennel, Morning Glory, Sorrel, or Bermuda grass.

F. Refer to Soil Preparation Plan for soil requirements.

3.3 PREPARATION

A. Protection:

1. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.

2. Be responsible for proper repair to utilities, walls, pavements and other site improvements damaged by operations under this section.

3. Pay for repairs made by contractor(s) designated by Owner.

4. Protect existing woody roots, shrubs and trees to remain.

5. Protect existing soil and slopes that exceed 3:1 slope. Do not disturb grade of slopes steeper than 3:1

B. Grass Removal: Remove surviving clumps of grass and dispose off-site. Rip and cross rip the existing soil 12” deep and till the dead organic matter into the existing soil.

C. Surface Grade: Remove grass, weeds, debris and rocks larger than 1". Dispose of accumulated debris.

D. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water to run off the grounds as is intended by the grades.

E. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited material on the site throughout duration of work.

F. Irrigation System Replacement: Cut, cap and remove existing irrigation equipment as required and noted on drawings and coordinate installation of new system and modifications of existing system as required.

G. Install landscape drainage as noted on drawings and specified in Section 32 8500.

3.4 SOIL PLACEMENT

A. Soil Placement:

1. Provide soil as noted on the drawings.

2. Protect improvements from damage due to landscape work.

3. Existing Soil Excavation: where import soil is required, excavate existing soil, as required, to clear existing vegetation and roots, meet finish grades and allow for soil preparation.

4. Inspect planting areas and remove all base rock and other foreign materials. Rip all planting areas in two directions full depth of compacted fill, to a minimum of 12-inches, into undisturbed native soil prior to backfilling. Scarification of any planting area, which cannot be accomplished with a tractor, shall be accomplished by an alternative method approved by the Landscape Architect to the specified depth to ensure proper drainage.

5. Uniformly distribute and spread soil backfill in planting areas in layers not to exceed 24" and compact to a maximum of 85% relative compaction.

6. When the planting soil differs in clay and silt content from the subsoil it is to be placed upon, install a 4-inch thick lift of planting soil on the subgrade and rototill into the subgrade 6-inches deep before installing the remaining required planting soil.

7. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.

8. Water settling, puddling, and jetting of fill and backfill materials, as a compaction method, is not acceptable.

9. Maintain moisture content of materials during compaction operations within required moisture range to obtain indicated compaction density.

10. Provide a minimum depth of import soil as noted on the drawings.

3.5 FINE GRADING AND SOIL PREPARATION FOR SLOPES EXCEEDING 3:1 SLOPE

A Before proceeding with the work: Carefully inspect all areas and verify all dimensions and quantities. Immediately inform the Landscape Architect of any discrepancy between the drawings and specifications and actual conditions and secure acceptance to proceed.

B. Inspect planting areas and remove and dispose of all invasive weeds, base rock and other foreign material including soils contaminated with cement or other materials or debris. Request photographs of invasive weeds if required for identification.

C. Planting operations shall be performed only during periods when beneficial results can be obtained. When excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped until conditions are satisfactory.

D. Thoroughly wet down the planting areas to settle the soil. Allow soil to dry so as to be workable.

E. Protect tree root systems from damage caused by equipment, runoff, and spillage of noxious materials and storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

F. Do not store construction materials, debris, or excavated material inside tree root zones.

G. Do not permit vehicles within tree root zones; prevent soil compaction over root systems.

H. Planting Soil Preparation:

1. Inspect planting areas and remove all rock, other foreign material and other objects over 1" in diameter. Scarify planting areas in two directions to a maximum of 1 inch.

2. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.

3. Water settling, puddling, and jetting of fill and backfill materials, as a compaction method is not acceptable.

4. Maintain moisture content of materials during compaction operations within required moisture range to obtain indicated compaction density.

5. Provide a minimum of 1 inch depth of friable soil in planting areas.

I. Planting area soil of planting areas shall be in a loose, friable condition prior to planting.

J. Drag to a smooth, even surface. Grade to form all swales, pitch to drain to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas which shall be uniformly level or sloped between finish elevations.

K. After the rototill work, float areas to a smooth, uniform grade as indicated on the drawings. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Remove rocks, sticks and debris 1/2 inch or larger in size in turf areas. Secure acceptance of the grade by the Landscape Architect before any planting.

L. Scarify all planting areas that become compacted prior to planting.

3.6 FINE GRADING AND SOIL PREPARATION FOR AREAS FLATTER THAN 3:1 SLOPE

A. Before proceeding with the work: Carefully inspect all areas and verify all dimensions and quantities. Immediately inform the Landscape Architect of any discrepancy between the drawings and specifications and actual conditions and secure acceptance to proceed.

B. Inspect planting areas and remove and dispose of all invasive weeds, base rock and other foreign material including soils contaminated with cement or other materials or debris; Request photographs of invasive weeds if required for identification.

C. Planting operations shall be performed only during periods when beneficial results can be obtained. When excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped until conditions are satisfactory.

D. Thoroughly wet down the planting areas to settle the soil. Allow soil to dry so as to be workable.

E. Planting Soil Preparation:

1. Inspect planting areas and remove all rock, other foreign material and other objects over 1" in diameter. Rip all planting areas in two directions full depth of compacted fill to a minimum of 12 inches.

2. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.

3. Water settling, puddling, and jetting of fill and backfill materials, as a compaction method is not acceptable.

4. Maintain moisture content of materials during compaction operations within required moisture range to obtain indicated compaction density.

5. Provide a minimum of 12 inches depth of friable soil in planting areas.

F. Planting area soil of planting areas shall be in a loose, friable condition prior to planting.

G. Drag to a smooth, even surface. Grade to form all swales, pitch to drain inlets, curb, etc., to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas which shall be uniformly level or sloped between finish elevations.

H. Spread soil amendment, iron or gypsum, and Type A fertilizer evenly over installed and rough graded topsoil in all turf areas at the following rates:

1. Soil Amendment: 6 cubic yards per 1,000 square feet.

2. Fertilizer: Type A at 10 lbs. per 1,000 square feet.

3. Soil Sulfur: 20 lbs. per 1,000 square feet or

4. Gypsum: 20 lbs. per 1,000 square feet.

5. Iron Sulfate: 15 lbs. per 1,000 square feet.

6. Potassium Sulfate (0-0-50): 12 lbs. per 1,000 square feet.

7. Treble Superphosphate: 0-48-0: 12 lbs. per 1,000 square feet

I. Rototill above additives into soil, 8 inches deep.

J. After the rototill work, float areas to a smooth, uniform grade as indicated on the drawings. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Remove rocks, sticks and debris 1/2 inch or larger in size in turf areas and 1 inch or larger in ground cover areas. Secure acceptance of the grade by the Landscape Architect before any planting.

K. Scarify all planting areas that become compacted prior to planting.

3.7 SOD INSTALLATION

A. When the landscape sprinkler system is completed, perform a coverage test in the presence of the Project Inspector to determine if the water coverage for planting areas is adequate.

B. In areas flatter than 3:1 slope and free of tree roots, Soil shall be friable to a depth of 6 inches with pre-plant fertilizer and soil amendment incorporated prior to installing sod.

C. In areas that exceed 3:1 slope pin sod to slope with 6” long galvanized steel staples.

D. Lightly roll surface and re-shape to level humps and hollows. Secure Landscape Architect's approval prior to sodding. Do not sod on dry soil. Keep sod moist and shaded prior to installation.

E. Firm soil. Smooth to uniform surface and verify that finish grade is the specified dimension below pavement, mow edge or curb as shown on the drawings.

F. For sodded grass areas: After completing soil preparation, fine grading, and irrigation coverage test and just before seeding and sod installation, broadcast Mycorrhiza at a rate of 2 pounds per 1,000 square feet on the soil surface that is to receive sod. Broadcast when it will not be disturbed by wind.

G. Arrange sod around trees, woody plants, exposed roots and shrubs and perennials.

H. Water area lightly immediately prior to installing sod.

I. Lay first strip of sod along a straight line (use a string in irregular areas). Butt joints tightly, do not overlap edges. On second strip, stagger joints. Use a sharp knife to cut sod to fit curves, edges and sprinkler heads.

J. When a conveniently large area has been sodded, water lightly to prevent drying. Continue to sod and to water until installation is complete.

K. After laying sod, roll lightly to eliminate irregularities and to form good contact between sod and soil. Avoid a heavy roller and excessive initial watering.

L. Thoroughly water the completed sod surface to at least 8 inches deep. Repeat sprinkling at regular intervals to keep sod moist at all times until rooted. After sod is established, decrease frequency and increase amount of water per application.

M. Eliminate low spots and divots by pulling sod back and filling with amended topsoil.

N. Fill gaps that form with prepared top dress material (1/2 sand, 1/2 organic material). Hand weed and re-sod areas that do not take every 14 days.

O. Protect sod from trespass and damage from animals. Immediately repair animal damage and provide program to keep animals from damaging sod. Protect turf areas by erecting fences, barriers and signs necessary to prevent trespass. Keep barriers neat and well maintained for not less then 60 days after sod planting.

3.8 TREE, SHRUB AND GROUNDCOVER PLANTING

A. Mark tree and shrub locations on site using stakes, gypsum or similar accepted means and secure location acceptance by the Landscape Architect before plant holes are dug. Adjust as necessary prior to planting.

B. Excavate plant pits as shown on the drawings:

C. Test drainage of tree pits by filling with water (minimum 6"). The retention of water in planting beds and plant pits for more than eight (8) hours shall be brought to the attention of the Landscape Architect. If rock, underground construction work, tree roots, poor drainage, or other obstructions are encountered in the excavation of plant pits, alternate locations may be selected by Landscape Architect.

D. Break and loosen the sides and bottom of the pit to ensure root penetration. Soil immediately below the rootball should be left undisturbed to provide support for the plant.

E. Carefully remove and set plants without damaging the rootball. Superficially cut edge roots vertically on three sides using a knife.

F. Set plants with top of the rootball 2 inches above finished grade. Backfill remainder of hole and soak thoroughly by jetting with a hose and pipe section. Water backfill until saturated the full depth of the hole.

G. Backfill plant holes with mix as specified, free from rocks, clods or lumpy material as follows:

1. Adjacent to the rootball, backfill native soil free of soil amendments to within 12" of finish grade and foot tamp to prevent settlement.

2. Backfill remainder of the hole with a mixture of 2 parts native soil free of soil amendments, and 1 part amendment:

3. Mix Mycorrhiza planting backfill with the planting backfill in the top 1” of the planting hole as close to the root ball and evenly distributed as possible at the following rates

4” pot or plug plant	- 1 teaspoon
1 gallon can plant	- 1 tablespoon
3 gallon can plant	- 3 tablespoons
5 gallon can plant	- 3 tablespoons
15 gallon can plant	- 6 tablespoons.
24-inch box plant	- 8 tablespoons
Larger plants	- 4 tablespoons per inch of trunk caliper at 6” above finish grade

H. Install fertilizer Type ‘B’ for 1-gallon plants and larger adjacent to the rootball per the manufacturer’s specifications. Install fertilizer Type ‘C’ for 4” pot or plug plant adjacent to the rootball per the manufacturer’s specifications.

I. Build 6" high watering basin berms around trees and shrubs to drain through rootball.

J. Stake trees as detailed. Drive stake until solid and remove excess stake protruding above top tree tie to prevent rubbing against branches.

K. Remove any soil from top of plant rootballs and secure Landscape Architect's acceptance of rootball height prior to mulching.

L. After acceptance of rootball height, mulch watering basins with organic mulch to 2-inch depth and thoroughly water.

3.9 GROUND COVER PLANTING

A. Plant in neat, straight, parallel and staggered rows as indicated on plan. Plant first row one-half required ground cover spacing behind adjacent curbs, structures, walls or other plant bed limits. Plant ground cover to edge of water basins of adjacent trees and shrubs.

3.10 VENTS and CLEANOUTS

A. Install plumb, level and square to adjacent structure or paving or as otherwise directed by Landscape Architect.

B. Connect to PVC pipe and storm drain system and make a complete watertight connection.

3.11 SUBSURFACE DRAINS

A. Install subsurface drains where indicated on the drawings and backfill with permeable material as specified. Provide not less than 3" of permeable material under pipe. Bell and spigot, and tongue and groove concrete pipe shall be laid without mortar in the joints, and lengths shall be pressed firmly together to prevent infiltration of fine material. Lay all pipe perforations down. Where subsurface drains connect to site drainage or plumbing systems, verify inverts of connections and lay pipe accordingly to drain. Connect to PVC pipe and storm drain system and make a complete watertight connection

3.12 SHEET MULCH

A. Remove as much surface vegetation, then amend and rototill as required.

B. Roll cardboard out, taking care to overlap cardboard minimum 6".

C. Soak Cardboard with water as it is rolled out in order to keep in place. Install 2 layers of cardboard, as shown in drawings (3 layers where plants are not to be installed)

D. Install 3" mulch layer over wetted cardboard (4" where plants are not to be installed).

E. Cut holes in cardboard for new plants.

F. Hold bark mulch away from base (trunk) of plant 2" to 4" or as directed by the Landscape Architect.

G. Omit cardboard in the bottom of infiltration basins. Cardboard should be installed on side slopes of basins.

H. Install sheet mulch at shrubs and trees in sod areas and where noted on drawings.

3.13 WATERING

A. Water plants immediately after planting. Apply water to all plants as often and in sufficient amount as conditions may require to keep the plants in a healthy vigorous growing condition until completion of the Contract. Do supplemental hand watering of plants and sod during the first 3 weeks of plant establishment.

3.14 MAINTENANCE OF PLANTING

A. Maintain plants from time of delivery to site until final acceptance of landscape installation.

3.15 PRE-MAINTENANCE PERIOD REVIEW AND ACCEPTANCE OF PLANTING

A. Receive acceptance of the installed planting prior to commencement of planting establishment maintenance period. Notify the Landscape Architect a minimum of seven (7) days prior to requested review. Before the review, complete the following:

1. Complete all construction work.

2. Present all planted areas neat and clean with all weeds removed and all plants installed and appearing healthy.

3. No partial acceptances will be given.

3.16 PLANTING ESTABLISHMENT MAINTENANCE

A. General Requirements:

1. The planting establishment maintenance period required shall be 365-calendar days after all planting is complete and installation accepted. A longer period may be required if the plant material is not acceptably maintained during the maintenance period. The maintenance period may be suspended at any time upon written notice to the Contractor that the landscaping is not being acceptably maintained, and the day count suspended until the landscape is brought up to acceptable standards as determined by the Landscape Architect.

2. Planting establishment maintenance immediately follows, coincides with, and is continuous with the planting operations and after all planting is complete and accepted; or longer where necessary to establish acceptable stands of thriving plants.

3. Protect all areas against damage, including erosion and trespass, and provide proper safeguards. Maintain and keep all temporary barriers erected to prevent trespass.

4. Keep all walks and paved areas clean. Keep the site clear of debris resulting from landscape work or maintenance.

5. Repair all damaged planted areas, and replace plants and reseed erosion control areas immediately upon discovery of damage or loss.
6. Check sprinkler systems at each watering; adjust coverage and clean heads immediately. Adjust timing of sprinkler controller to prevent flooding.

7. Maintain adequate moisture depth in soil to ensure vigorous growth. Check rootball of plants independent of surrounding soils and hand water as required.

8. Keep Contract areas free from weeds by cultivating, hoeing or hand pulling. Use of chemical weed killers will not relieve the Contractor of the responsibility of keeping areas free of weeds over 1-inch high at all times.

9. Any day the Contractor fails to adequately water, replace unsuitable plans, weed, and other work determined to be necessary by the Architect, will not be credited as part of the establishment period.

B. Tree, Shrub, Groundcover and Sod Maintenance:

1. Maintain during the entire establishment period by regular watering, cultivating, weeding, and spraying for insect pests. Prune when requested by the Landscape Architect.

2. Keep watering basins in good condition and weed-free at all times. Maintain a daily log of watering times on the job site and make available for inspection by the Architect.

3. Replace all damaged, unhealthy or plants with new stock immediately; size as indicated on the drawings.

C. Sod Maintenance:

1. Maintain during the entire establishment period.

2. Cut as recommended by sod grower. Generally do not cut it and never cut more then 1/3 of the leaf at any one cutting.

3. Sod shall be well established, free of bare spots and weeds, and of a “sod-like” quality to the satisfaction of the Landscape Architect prior to Final Acceptance.
3. Maintain constant moisture to a depth of eight inches (8").

4. Keep sod areas free of undesirable weeds and grasses by the application of suitable selective weed killers or hand pulling. Use Integrated Pest Management practices that use the least toxic practices.

5. Re-sod all damaged areas as soon as evident.

6. Repair any hollow, settled or eroded areas by filling, rolling and reseeding or re-sodding.

7. Grass shall be green at all times.

D. Fertilizing:

1. For the sod areas, the first fertilization should be four weeks after planting. Upon approval and after submitting fertilizer delivery tags, fertilize turf areas by

broadcasting Type A fertilizer, at a rate of 10 pounds per 1,000 square feet t evenly throughout.

2. Reapply Type A fertilizer at the rate of 10 lbs. per 1,000 square feet evenly throughout to all areas every ninety (90) days until acceptable.

3. Soil Testing During the Planting Establishment Maintenance Period:

   a. Topsoil Analysis: Approximately 60 days after the initiation of the planting establishment maintenance period, obtain two representative samples of topsoil taken from accepted site locations (one from front lawns and one from courtyards) and submit to an accredited Soils Laboratory for analysis report and recommendations for maintenance fertilizer.

   b. Upon acceptance of the Laboratory's report by the Landscape Architect, the recommendations in the report shall become a part of the Specifications and the quantities of fertilizer and other additives shall be adjusted to conform to the report.

   c. When taking the soils samples, use a soil probe and pull at least 30 plugs from the site to a depth of 6" to 8" deep. Mix them all together in the same container and call it one sample. Send in approximately a quart sample for each test.

4. Apply fertilizer as necessary to maintain vigorous, green grass and stimulate root growth as required.

5. Observe plant's color, and if a soil pH imbalance is suspected, take soil samples and obtain laboratory analysis for confirmation. Take necessary action recommended in laboratory analysis such as top dressing with soil sulfur, leaching soil, etc.

3.17 FINAL PLANTING REVIEW AND ACCEPTANCE

A. At the conclusion of the planting establishment period, schedule a final review with the Owner, the Owner's maintenance person, and the Landscape Architect. On such date, all project improvements and all corrective work shall have been completed. If all project improvements and corrective work is not completed, continue the planting establishment, at no additional cost to the Owner, until all work has been completed. This condition will be waived by the Owner under such circumstances wherein the Owner has granted an extension of time to permit the completion of a particular portion of the work beyond the time of completion set forth in the Agreement.

B. Submit written notice, requesting review at least 10 days before the anticipated review.

C. Prior to review, weed and rake all planted areas, repair plant basins, plumb tree stakes, clear the site of all debris and present in a neat, orderly manner.

3.18 CLOSEOUT

A. Include copies of the material submittals and manufactured material suppliers and installers name and telephone number in the Operations and Maintenance manuals as part of the closeout documents.

B. Include warranty per Article 1.5 and manufacturer's warranty information of specified items with warranties.

END OF SECTION – 32 90 00

SECTION 32 31 19 - ORNAMENTAL FENCING and GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ornamental Fence and accessories.

1.02 RELATED SECTIONS

A. Section 32 13 13, Landscape Concrete

B. Section 32 90 00, Planting

1.03 SUBMITTALS

A. Procedures: In accordance with Division 01.

B. Shop Drawings: Layout of fences and gates with dimensions, details, and finishes of hardware components, accessories, connections and post foundations.

C. Product Data: Manufacturer's catalog cuts indicating material compliance and specified options.

D. Samples: Color selection for polymer finishes and samples of materials (e.g., finals, caps, and accessories).

1.04 ACCESSIBILITY COMPLIANCE

A. Gates: Gates in path of travel must comply with exit door requirements. (CBC 2022 Sections 1005.2, 1008, 1015, & 1020.2). Provide hardware that does not require pinching, grasping, or twisting motion to operate and provide solid kick plates 10 inches high minimum, 3 inches maximum from paving on both sides of gate.

B. Walk-Through Gates: Comply with CBC 2022 Section 1008.1.10 (Panic Hardware) or show in compliance with CBC 2022 Section 1008.2 (Gates).

1.05 SOILS REPORT

A. A soil investigation report has prepared for the project

B. The reports are available in the office of the Architect and the Construction Manager for inspection by the Contractor. Unless otherwise specified, it is intended that all work be performed in accordance with the provisions of these reports.

C. According to the Geotechnical Engineer, drilled piers may encounter ground water. Excavations for drilled piers may require casings and installation of concrete by means of pumping under the direction of the Geotechnical Engineer.

1.06 SOILS BORINGS

A. Subsurface soils investigations have been made at the site and logs of the test holes are available with the Soils Report. Such investigations have been made for the purposes of design only, and neither the Landscape Architect, the Owner, nor the Soils Engineers guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations.

1.07 PROJECT CONDITIONS

A. Coordination: Coordinate this work with the work of other Sections to avoid delay and interference with other work.

B. Protect excavations by shoring, bracing, sheeting, underpinning, or other methods as required to prevent cave-ins or loose dirt from entering excavations. Barricade open excavations and post warning lights at work adjacent to public streets and walks.

C. Promptly repair damage to adjacent facilities caused by operations. Cost of repair at Contractor's expense.

D. Promptly notify the Inspector of unexpected subsurface conditions.

E. Excavations and Sidewall Support: Excavations to depths greater than 4.5 feet will require shields or shoring per OSHA regulations and OSHA recommendations and procedures.

F. Excavations Stabilization and Dewatering Considerations: In instances where excessive caving or unstable wall conditions are encountered, the Geotechnical Engineer may recommend that trench shields be used both for worker safety and to maintain integrity of the trench. Minimizing the length of excavation open at one time will also minimize excavation instability. Also, for this condition, the Geotechnical Engineer recommends the need to keep excavations open as short a time as possible before backfilling. The risk of excavation wall squeezing and bottom heave increases with time.

1.08 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.09 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.

C. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

D. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

E. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

F. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

G. ASTM D523 - Test Method for Specular Gloss.

H. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.

I. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

K. ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

L. ASTM F1184 – Industrial & Commercial Horizontal Slide Gates

M. CBC 11B-404 – Doors, Doorways and Gates

1.10 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.11 PRE-INSTALLATION MEETINGS

A. Section 01300 – Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.12 WARRANTY

A. The powder-coated surface on all framework (i.e., pickets, rails and posts) by AMERISTAR® is warranted under normal and proper usage, against cracking, peeling, chipping, blistering or corroding for a period of ten (10) years from the original purchase date. Normal and proper usage does not include physical damage, abrasion or exposure to salty environments to the protective coating.

B. Aegis II™ Industrial Ornamental Metal Fencing System framework is also warranted for the same period of time against defects in workmanship or materials.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Products from qualified manufacturers having a minimum of 5 years experience manufacturing ornamental picket fencing will be acceptable by the District as equal if they meet the following specifications for design, size, gauge of metal parts and fabrication.

B. Ornamental Picket Fence: As shown on Drawings.

C. Approved Manufacturer: Ameristar Fencing, Tulsa, OK, Phone 888-333-3422, (918) 835-0898 or accepted equal.

D. Local Ameristar regional distribution centers, Stockton, CA 95210.

2.02 MATERIALS

A. The fence system shall conform to Ameristar Montage II, Majestic, design, 2-Rail style manufactured by Ameristar Fence Products, Inc. in Tulsa, Oklahoma.

B. Steel material for fence framework (i.e. tubular pickets, rails and posts), shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.

C. Material for pickets shall be 1” square x 14 Ga. tubing. The cross-sectional shape of the rails shall conform to the manufacturer’s ForeRunner double wall design with outside cross-section dimensions of 1.75” square and a minimum thickness of 14 Ga. Picket holes in the ForeRunner rail shall be spaced 4.715” o.c., except for Invincible style 6’ long, which shall be, spaced 4.98” o.c. Picket retaining rods shall be 0.125” diameter galvanized steel. High quality PVC grommets shall be supplied to seal all picket-to-rail intersections. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.03 FABRICATION

A. Pickets, rails and posts shall be precut to specified lengths. ForeRunner rails shall be prepunched to accept pickets. Pickets shall be predrilled to accept retaining rods.

B. Grommets shall be inserted into the prepunched holes in the rails and pickets shall be inserted through the grommets so that predrilled picket holes align with the internal upper raceway of the ForeRunner rails (Note: This can best be accomplished by making an alignment jig). Retaining rods shall be inserted into each ForeRunner rail so that they pass through the predrilled holes in each picket.

C. The manufactured galvanized framework shall be subjected to the PermaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pretreatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.

D. Completed sections (i.e., panels) shall be capable of supporting a 600 lb. load applied at midspan without permanent deformation. Panels shall be biasable to a 25% change in grade.

E. Swing gates shall be fabricated using 1.75” x 14ga Forerunner double channel rail, 1.75” sq. x 14ga. gate ends, and 1” sq. x 14ga. pickets. Gates that exceed 6’ in width will have a 1.75” sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.

2.04 GATES

A. Ornamental picket swing gates as shown on Drawings. Comply with requirements for accessibility and fire existing.

B. Coordinate requirements for illuminated exit signs.

C. Accessible Gate Latch: As required to meet California Building Code requirements for accessible access. Submit manufacturers cut sheet and sample.

D. See drawings for all hardware and keying information, including cylinders.

2.05 SETTING MATERIAL

A. Concrete: Minimum 28-day compressive strength of 3,000 psi (20 MPa).

2.06 TABLES

Table 1 – Minimum Sizes for Montage II Posts				
Fence Posts	Panel Height			
2-1/2" x 12 Ga.	Up to & Including 6' Height			
3" x 12 Ga.	Over 6' Up to & Including 10' Height			
4" x 11 Ga.	Over 10' Height			
Gate Leaf	Gate Height			
	Up to & Including 6'	Over 6' Up to & Including 8'	Over 8' Up to & Including 10'	Over 12'
Up to 4'	3" x 12Ga.	3" x 12 Ga.	4" x 11 Ga.	4" x 11 Ga.
4'1" to 6'	3" x 12Ga.	3" x 12 Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"	6" x 3/16"
10'1" to 12'	6" x 3/16"	6" x 3/16"	6" x 3/16"	8" x 1/4"
12'1" to 16'	6" x 3/16"	6" x 3/16"	8" x 1/4"	8" x 1/4"

Table 2 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60-inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 - Montage II – Post Spacing By Bracket Type						
Span	For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92.625" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Universal (BB302)	Industrial Universal (BB303)	Industrial Flat Mount (BB301)		Industrial Swivel (BB304) *	
Post Settings ± ½" O.C.	96"	96.5"	96"	96-1/2"	*96"	*96-1/2"
Span	For CLASSIC, GENESIS, & MAJESTIC 6' Nominal (71.375" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Universal (BB302)	Industrial Universal (BB303)	Industrial Flat Mount (BB301)		Industrial Swivel (BB304) *	
Post Settings ± ½" O.C.	71.5"	72"	71.5""	72"	*73"	*73.5"

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify areas to receive fencing are completed to final grades and elevations.

B. Ensure property lines and legal boundaries of work are clearly established.

3.02 PREPARATION

All new installations shall be laid out by the contractor in accordance with the construction plans.

3.03 FENCE INSTALLATION

A. Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posters with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of as shown in drawings. The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.04 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufacturers' warranty.

3.05 GATE INSTALLATION

A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application, weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

B. Install gates plumb, level and secure for full opening without interference.

C. Attach hardware by means, which will prevent unauthorized removal.

D. Adjust hardware for smooth operation.

E. Accessible Gate Hardware: Install as required to meet California Building Code requirements for accessible access and as shown on drawings.

3.06 FINAL REVIEW AND CLEANUP:

A. Clean up debris and unused material and remove it from site.

B. Include copies of the material submittals and manufactured material suppliers and installers name and telephone number in the Operations and Maintenance manuals as part of the closeout documents.

C. Include manufacturer's warranty information of specified items with warranties.

D. In accordance with Sections 01730 and 01770.

END OF SECTION

SECTION 33 10 00

WATER SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Site water distribution system for domestic and fire protection services up to 5 feet of any on-site 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 31 21 00, Utility Trenching and Backfill

1.3 RELATED DOCUMENTS

A. ASME
1. ASME A112.1.2: Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water Connect Receptors
2. ASME B1.20.1: Pipe Threads, General Purpose, Inch
3. ASME B16.1: Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
4. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
5. ASME B16.22: Wrought Copper and Copper Alloy Solder – Joint Pressure fittings
6. ASME B16.26: Cast Copper Alloy Fittings for Flared Copper Tubes

B. ASTM
1. ASTM A536: Standard Specification for Ductile Iron Castings
2. ASTM A674: Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
3. ASTM B61: Standard Specification for Steam or Valve Bronze Castings
4. ASTM B62: Standard Specification for Composition Bronze or Ounce Metal Castings
5. ASTM B88: Standard Specification for Seamless Copper Water Tube
6. ASTM C94: Standard Specification for Ready-Mixed Concrete
7. ASTM D1785: Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
8. ASTM D2564: Standard Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Piping Systems
9. ASTM F1056: Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings

C. AWWA
1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C110: Ductile-Iron and Gray-Iron Fittings

4. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. C115: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
6. C116: Protective Fusion-Bonded Epoxy Coatings for the Interior & Exterior Surfaces for Ductile-Iron and Gray-Iron Fittings
7. C150: Thickness Design of Ductile-Iron Pipe
8. C151: Ductile-Iron Pipe, Centrifugally Cast
9. C153: Ductile-Iron Compact Fittings
10. C200: Steel Water Pipe 6 inch and larger
11. C203: Coal-Tar Protective Coatings and Linings for Steel Water Pipe
12. C205: Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 inch and Larger-Shop Applied
13. C207: Steel Pipe Flanges for Waterworks Service-Sizes 4 inch through 144 inch
14. C208: Dimensions for Fabricated Steel Water Pipe Fittings
15. C209: Cold Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings
16. C210: Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
17. C213: Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
18. C214: Tape Coatings for Steel Water Pipelines
19. C218: Liquid Coatings for Aboveground Steel Water Pipe and Fittings
20. C219: Bolted, Sleeve-type Couplings for Plain-End Pipe
21. C500: Metal-Seated Gate Valves for Water Supply Service
22. C502: Dry-Barrel Fire Hydrants
23. C503: Wet Barrel Fire Hydrants
24. C504: Rubber Seated Butterfly Valves.
25. C507: Ball Valves, 6 inch through 60 inch.
26. C508: Swing-check Valves for Waterworks Service, 2 inch through 48 inch NPS.
27. C509: Resilient-Seated Gate Valves for Water Supply Service
28. C510: Double Check Valve Backflow Prevention Assembly
29. C511: Reduced-Pressure Principle Backflow Prevention Assembly
30. C512: Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
31. C550: Protective Interior Coatings for Valves and Hydrants
32. C600: Installation of Ductile-Iron Water Mains and Their Appurtenances
33. C606: Grooved and Shouldered Joints
34. C651: Disinfecting Water Mains
35. C800: Underground Service Line Valves and Fittings
36. C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 60 inch for Water Transmission and Distribution
37. C901: Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inch for Water Service
38. C905: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inch through 48 inch for Water Transmission and Distribution
39. C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 65 inch, for Waterworks
40. M11: Steel Pipe - A Guide for Design and Installation
41. M23: PVC Pipe – Design and Installation
42. M41: Ductile-Iron Pipe and Fittings

D. Factory Mutual Insurance Company (FM)
   1. FM 1530: Fire Department Connections

E. National Fire Protection Association (NFPA)
   1. NFPA 24: Installation of Private Fire Service Mains and Their Appurtenances
   2. NFPA 70: National Electric Code
   3. NFPA 1963: Fire Hose Connection

F. National Sanitation Foundation (NSF)
   1. NSF 61: Drinking Water System Components-Health Effects

G. Underwriters Laboratory(UL)
   1. UL 262: Safety Gate Valves for Fire-Protection Service
   2. UL 405: Safety Fire Department Connection Devices
   3. UL 789: Indicator Posts for Fire-Protection Service

1.4 DEFINITIONS

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

B. ASTM: American Society for Testing Materials

C. AWWA: American Waterworks Association

D. DI: Ductile iron

E. DIP: Ductile iron pipe

F. FM: Factory Mutual

G. NFPA: National Fire Protection Association

H. NSF: National Sanitation Foundation

I. PCC: Portland cement concrete

J. PE: Polyethylene

K. PVC: Polyvinyl Chloride

L. UL: Underwriters Laboratory

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Minimum Working Internal Pressures: 150 PSI for both Fire and Domestic systems.

B. External Load: Earth load indicated by depth of cover plus AASHTO H20 live load unless indicated otherwise.

1.6 SUBMITTALS

A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.

B. Product Data: Manufacturer's literature and data, including, where applicable, sizes, pressure rating, rated capacity, listing/approval stamps, labels, or other marking on equipment made to the specified standards for materials, and settings of selected models, for the following:

1. Piping materials and fittings
2. Gaskets, couplings, sleeves, and assembly bolts and nuts
3. Flexible pipe fittings
4. Restrained pipe fittings
5. Flexible Connectors
6. Expansion joints
7. Flexible expansion joints
8. High deflection fittings/ball joints
9. Gate valves
10. Butterfly valves
11. Check valves
12. Ball valves
13. Air release, air/ vacuum and combination air valves
14. Blow-off valves
15. Pressure reducing valves
16. Flow Regulating valves
17. Service connections and water meters
18. Valve boxes, meter boxes, frames and covers
19. Backflow preventers
20. Fire hydrants
21. Post indicator valves
22. Fire department connections
23. Thrust block concrete mix
24. Tapping sleeves and tapping valves
25. Service saddles and corporation stops
26. Identification materials and devices

C. Shop Plans and Calculations: Where an on-site fire water system is required, Contractor shall provide shop plans for Engineer and agency approval prior to construction. Coordinate with the Plans and identify any proposed modifications or deviations. Shop Plans and Calculations shall be stamped and signed by a registered Fire Protection Engineer licensed by the State of California as required.

1. Include the following information:
    a. Design assumptions
    b. Thrust block sizing and calculations
    c. Materials to be used
    d. Available water pressure
    e. Required water pressure
2. The review of fire system components constitutes only a portion of the review and approval required. A copy of the fire system component submittal package shall be forwarded to the local fire marshal for further review and approval.

D. Water Pressure Report: At the conclusion of work, the Contractor shall engage a qualified testing service to conduct a flow test of the existing system (providing flow test data for all mains and at least six (6) hydrants). Provide date and location of test, type and method of test performed, static pressure and residual pressure in psig, observed flow in gpm, and orifice size.

E. Shop drawings: Include plans, elevations, details and attachments.
1. Precast and cast in-place vaults and covers
2. Wiring diagrams for alarm devices

F. 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 company representative.

B. Comply with the following requirements and standards:
1. NSF 61: “Drinking Water System Components-Health Effects” for materials for potable water.
2. NFPA 24: “Installation of Private Fire Service Mains and Their Appurtenances” for materials, installations, tests, flushing, and valve and hydrant supervision.
3. NFPA 70: “National Electric Code” for electrical connections between wiring and electrically operated devices.

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.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

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. 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 COPPER PIPE: SIZES ¾ INCH THROUGH 3 INCH

A. Pipe and Fittings: Provide Type K soft or hard copper pipe, seamless water tube, annealed conforming to ASTM B88.

B. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18.

C. Wrought copper solder-joint pressure fittings or wrought copper alloy unions shall conform to ASME B16.22

D. Cast copper alloy flare fittings shall conform to ASME B16.26.

E. Wrought copper alloy body, hexagonal stock, metal-to-metal seating surfaces, and solder-joint threaded ends shall conform to ASME B1.20.1.

F. Compression connections shall be Mueller 110, Ford or approved equal.

G. Joints: Restrain by couplings.

2.2 DIP: SIZES 4 INCH THROUGH 48 INCH

A. Pipe: Pressure Class 250 pipe conforming to AWWA C151, AWWA Manual M41 and standard thickness per AWWA C150. U.S. Pipe, American Cast Iron Pipe Company, or approved equal.

B. Fittings: Provide fittings with pressure rating greater than or equal to that of the adjoining pipe.

C. Pipe and Fitting Lining: Cement Mortar, AWWA C104.

D. Pipe and Fitting Coating: Asphaltic, AWWA C151 or C115.

E. Fittings
1. Standard: AWWA C110, sizes 4 inch through 48 inch.
2. Compact: AWWA C153, sizes 4 inch through 24 inch.
3. All fittings shall be fusion epoxy coated per AWWA C116.

F. Exterior Soil Corrosion Protection for Pipe and Fittings: Polyethylene encasement, AWWA C105.

G. Unrestrained Joints (Rubber Gasket Joints):
1. Push-On Bell and Spigot Joint: Provide shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly conforming to AWWA C111.
2. Mechanical Joint: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111.

H. Restrained Joints:
1. Flanged Joint: Provide bolts, nuts, and gaskets in conformance with AWWA C115. Gaskets shall conform to the requirements specified in AWWA C111. Unless otherwise required, above ground flange assembly bolts shall be standard hex-head, cadmium plated machine bolts with American Standard Heavy, hot–pressed, cadmium plated hexagonal nuts. Buried flange nuts and bolts shall be as above except they shall be of Type 304 stainless steel.
2. Push-On Bell and Spigot Joint: Provide shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly conforming to 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, or approved equal. “Megalug” restraint harness, EBAA Iron, or approved equal.
3. Mechanical Joint: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111 with “Megalug,” sizes 3 inch through 48 inch, EBAA Iron, or approved equal.
4. Grooved and Shouldered Joints: AWWA C150, AWWA C151 and AWWA C606. 24 inch maximum size.

I. Insulating Joints:
1. Provide a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact at the joint between adjacent sections of dissimilar metals.
2. Provide joint of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers.
3. Provide gasket of the dielectric type, full face, as recommended in AWWA C115.
4. Provide bolts and nuts as recommended in AWWA C115.

J. Couplings:
1. Plain End Pipe to Plain End Pipe: Ductile iron or steel bolted couplings, manufacturer’s shop coating with ***Stainless steel bolts and nuts.*** Smith-

Blair, Inc., Dresser, or approved equal. Anchor studs at locations where joints must be restrained.

2. Plain End Pipe to Flanged Pipe: 1) Ductile iron or steel bolted flanged coupling adapters, manufacturer's shop coating with low stainless steel bolts and nuts. Steel flanged couplings to conform to AWWA C219. Smith-Blair, Inc., Dresser, or approved equal. Anchor studs at locations where joints must be restrained; or 2) restrained flange adapter, "Megaflange," sizes 3 inch through 48 inch, EBAA Iron, or approved equal.

2.3 PVC PIPE: SIZES 4 INCH THROUGH 48 INCH

A. Pipe: Pressure Class 305, DR 14, spigot and gasket bell end, conforming to AWWA C900 (4 inch through 12 inch and AWWA C905 (14 inch through 48 inch)

B. Fittings: Ductile iron fittings
   1. Standard: AWWA C110, sizes 4 inch through 48 inch
   2. Compact: AWWA C153, sizes 4 inch through 24 inch
   3. All fittings shall be fusion epoxy coated per AWWA C116

C. Unrestrained Joints: Push-On Bell and Spigot Joint: AWWA C900

D. Restrained Joints:
   1. Push-On Bell and Spigot Joint: Harness assembly as manufactured by EBAA Iron, or approved equal.
   2. Plain End PVC to Ductile Iron Mechanical Joint: EBAA Iron, or approved equal.

E. Steel or Ductile Iron Couplings:
   1. Plain End Pipe to Plain End Pipe: Ductile iron or steel bolted couplings, manufacturer's shop coating with stainless steel bolts and nuts. Steel couplings to conform to AWWA C219. Smith-Blair, Inc., Dresser, or approved equal. Anchor studs at locations where joints must be restrained.
   2. Plain End Pipe to Ductile Iron or Steel Flanged Pipe: Ductile iron or steel bolted flanged coupling adapters, manufacturer's shop coating with stainless steel low bolts and nuts. Steel flanged couplings to conform to AWWA C219. Smith-Blair, Inc, Dresser or approved equal. Anchor studs or locking pins at locations where joints must be restrained.

F. PVC Couplings:
   1. Unrestrained Plain End to Plain End Pipe: AWWA C900, as manufactured by North American Piper approved equal.
   2. Restrained Plain End to Plain End Pipe: AWWA C900, "Fluid-Tite" as manufactured by North American Pipe, or approved equal.

2.4 FLEXIBLE CONNECTORS

A. Flanged Coupling Adapters for plain end pipe at fittings, valves and equipment shall be Dresser Style 127 or 128, similar models by ITT; Baker Coupling Company or approved equal. Nuts, bolts and other hardware shall be Type 304 stainless steel.

B. Mechanical Couplings shall be rated for a minimum working pressure of 150 psi. The barrel shall be a minimum 10 inches long. Couplings shall be cleaned and shop primed with manufacturer's standard rust inhibitive primer. Mechanical couplings

shall be Smith-Blair, Romac, JCM, Apac or approved equal, with stainless steel nuts, bolts, and threaded rods.

C. Flexible Coupling for Steel Pipe shall be Dresser Coupling Style 38 with EPDM gaskets, or approved equal.

2.5 EXPANSION JOINT

A. An expansion joint shall be installed at location indicated on the Plans and shall be manufactured of ductile iron conforming to the material properties of AWWA C153.

B. Separation beyond the maximum extension of the expansion joint shall be prevented without the use of external tie rods.

C. The expansion joint shall be pressure tested against its own restraint to a minimum of 250 psi.

D. All pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy, conforming to the applicable requirements of AWWA C213, and shall be tested with a 1500 volt spark test conforming to stated specification.

E. Mechanical or Flanged Joint: The expansion joint shall be Model Ex-Tend 200, 4 inch through 36 inch, as manufactured by EBAA Iron, Inc., or approved equal.

F. TR Flex Joints: TR Flex Telescoping Sleeve, 4 inch through 64 inch, U. S. Pipe.

2.6 FLEXIBLE EXPANSION JOINTS

A. Flexible expansion joints shall be installed at locations indicated on the Plans and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and AWWA C153.

B. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 250 psi. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.

C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of 15º, and 6 inches minimum expansion. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.

D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.

E. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C116

F. Polyethylene sleeves, meeting AWWA C105, shall be included for direct buried applications.

G. Flanged or mechanical Joint: Flexible expansion joint shall be Force Balanced FLEX-TEND, sizes 3 inch through 48 inch, as manufactured by EBAA Iron, or approved equal.

H. Flanged Joint: Starflex, Series 5000, Star Pipe Products, or approved equal.

I. Plain End to Plain End Pipe: “Xtra Flex,” sizes 4 inch through 24 inch, U. S. Pipe, or approved equal.

2.7 HIGH DEFLECTION FITTINGS/BALL JOINTS

A. Plain End Pipe: Xtra Flex Restrained Joint High Deflection Fittings, 4 inch through 24 inch, U. S. Pipe, or approved equal.

B. Mechanical or Flanged Joint: Flex 900, 4 inch through 12 inch, EBAA Iron, or approved equal.

2.8 GATE VALVES

A. Provide valves conforming to AWWA C500 or AWWA C509

B. Valves shall be resilient-seated, with 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.

C. All bolts, nuts and washers, except operating nut, shall be stainless steel.

D. Stem operating nut to be 2 inches square and open counter-clockwise.

E. 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.

F. Equip valves in pump stations and other interior or vault installations with hand-wheels. ***[Verify this with the system owner]***.

G. Provide protective epoxy interior and exterior coating according to AWWA C550 and manufacturer’s recommendations.

H. For the domestic water system, valves shall also conform to NSF 61.

I. Service vine Valves and fittings, 2 inch and smaller shall be in accordance with AWWA C800

J. Where a post indicator is shown, provide valve with an indicator post flange.

K. 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. Mueller Company
2. M&H Valve Company
3. Crane Company, or approved equal

2.9 SWING CHECK VALVES

A. Provide swing-check type valves conforming to AWWA C508.

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. Mueller Company
   2. M&H Valve Company
   3. DeZurik/APCO
   4. Watts, or approved equal

2.10 BALL VALVES

A. Provide ball valves (6 inch through 48 inch) per AWWA C507 as manufactured by Crane Company, or approved equal.

B. Provide ball valves (2 inches and smaller) conforming to AWWA C800 as manufactured by Mueller 300 Series, Ford, or approved equal.

C. Valves shall open by counterclockwise rotation of the valve stem.

D. Provide valves with ends as appropriate for the adjoining pipe.

E. Provide valve with lockable operating nut or handle as shown on the Plans.

2.11 AIR RELEASE, AIR/VACUUM AND COMBINATION AIR VALVES

A. Air release and vacuum valves: Provide valve and service size as shown on the Plans. Valve shall have cast-iron single valve body, and shall conform to AWWA C512. A compound lever system shall have a maximum operating pressure of 300 psi. Provide a protective cap for the outlet of the valve. Provide universal air-vacuum type valves, Crispin, DeZurik/APCO or approved equal.

B. Combination air valves: Provide valve and service size as shown on the Plans. Valve shall have cast-iron single valve or double valve body, and shall conform to AWWA C512. A simple or compound lever system shall have a maximum operating pressure of 300 psi. Provide a protective cap for the outlet of the valve.

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:
   1. Crispin
   2. DeZurik/APCO, or approved equal

2.12 BLOW-OFF VALVES

A. Provide valve and service size as shown in the Plans. Provide 2 inch valves at low points of the piping system, and 4 inch valves at dead-ends of the piping system, unless otherwise directed by the Engineer.

B. 2 inch blow-off shall have a 2 inch vertical female iron pipe (FIP) inlet and a 2 inch normal pressure and temperature (NPT) nozzle outlet with cap. Valve shall open by

counterclockwise rotation of a top-mounted 9/16 inch square operating nut. All working parts shall be serviceable without excavation. Kupferle/Truflo Model TF550, or approved equal.

C. 4 inch blow-off shall have all brass principal working parts, 4 inch inlet and outlet and is self-draining and non-freezing. Valve shall open by counterclockwise rotation of a top-mounted 2 inch square operating nut. All working parts shall be serviceable without excavation.

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:

E. Kupferle/ MainGuard #7600, or approved equal

2.13 PRESSURE-REDUCING 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.

B. Valves shall have flanged ends. Valves sized 3 inches or smaller may have screwed ends.

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:
1. Cla-Val Company
2. Bermad
3. Ames Company, or approved equal

2.14 SERVICE CONNECTIONS AND WATER METERS

A. Service connections and water meter details and boxes as indicated.

2.15 VALVE BOXES, METER BOXES, FRAMES AND COVERS

A. Water Valve Box: Provide pre-cast concrete valve box for each buried valve. Provide box with steel or cast iron traffic cover marked “WATER”. Christy Model G5 with G5C cover or approved equal.

B. Valve or Meter Boxes: Contractor shall verify box size required for water system appurtenances as shown in the Construction Documents. Provide a precast concrete utility box for each buried appurtenance. Provide a traffic-rated lid for H20 loading. A non-traffic rated lid may be used for boxes located in landscape areas. Christy, or approved equal.

2.16 BACKFLOW PREVENTER - REDUCED PRESSURE PRINCIPLE ASSEMBLIES (RPPA)

[LOCAL HEALTH DEPARTMENT OR OWNER OF SYSTEM MAY HAVE LIST OF ACCEPTABLE REDUCED-PRESSURE-PRINCIPLE BACKFLOW PREVENTER MANUFACTURERS AND MODELS THAT ARE ACCEPTABLE. THE STATE OF CALIFORNIA DEPARTMENT OF HEALTH SERVICES ISSUES A LIST OF APPROVED

BACKFLOW PREVENTION ASSEMBLIES. ALSO A REDUCED-PRESSURE-PRINCIPLE DETECTOR BACKFLOW PREVENTER IS ALSO AVAILABLE.]

A. Provide RPPA consisting of two independently operating check valves with a pressure differential relief valve located between the two check valves, two shut-off valves and four test cocks. RPPA shall be tamper-proof and conform to AWWA C511. Valve shall have an outside screw (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.

B. Body:
1. 2 inch and Smaller: Bronze with threaded ends
2. 2 ½ inch and Larger: Bronze, cast iron steel, or stainless steel with flanged ends

C. Interior Lining: AWWA C550, epoxy coating for cast iron or steel bodies

D. Interior Components: Corrosion-resistant materials

E. 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. Cla-Val Company
2. Ames Company
3. Febco, CMB Industries, Inc.
4. Hersey Products, Inc.
5. Watts
6. Zurn/Wilkins, or approved equal

2.17 BACKFLOW PREVENTER - DOUBLE CHECK DETECTOR ASSEMBLY (DCDA) ***[REVIEW DOUBLE CHECK DETECTOR ASSEMBLY WITH LOCAL AGENCY HAVING JURISDICTION. LOCAL FIRE DEPARTMENT OR OWNER OF SYSTEM MAY HAVE LIST OF DOUBLE CHECK DETECTOR ASSEMBLY MANUFACTURERS AND MODELS THAT ARE ACCEPTABLE. THE STATE OF CALIFORNIA DEPARTMENT OF HEALTH SERVICES ISSUES A LIST OF APPROVED DOUBLE CHECK DETECTOR ASSEMBLIES. ALSO A SINGLE CHECK DETECTOR ASSEMBLY IS ALSO AVAILABLE.]***

A. Provide a cast-iron body DCDA consisting of mainline double check assemblies in parallel with a bypass double check and meter assembly, two shut-off valves and four test cocks. DCDA shall be tamper-proof and conform to AWWA C510. FM approved or UL listed, with outside screw and yoke (OS&Y) gate valve on inlet and outlet, and strainer on inlet. Include two positive-seating check valves and test cocks, and bypass with displacement-type water meter, valves, and double-check backflow preventer, for continuous pressure application.

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. Cla-Val Company
2. Ames Company
3. Febco, CMB Industries, Inc.
4. Hersey Products, Inc.

5. Zurn/Wilkins, or approved equal

2.18 POST INDICATOR VALVE ***[REVIEW REQUIREMENTS FOR POST INDICATOR VALVE WITH AGENCY HAVING JURISDICTION.]***

A. General: UL 789, FM approved, vertical-type, cast-iron body with operating wrench extension rod, and adjustable cast-iron barrel of length required for depth of bury of valve. ***[Review fire department connection with agency having jurisdiction. Check hose threads and all sizes with fire department.]***

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. Mueller Company
2. Clow Corporation
3. American Cast Iron Company

2.19 FIRE DEPARTMENT CONNECTION ***[REVIEW FIRE DEPARTMENT CONNECTION WITH AGENCY HAVING JURISDICTION. CHECK HOSE THREADS AND SIZES WITH LOCAL FIRE DEPARTMENT.]***

A. Exposed, sidewalk or Freestanding Type 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. Number of inlets shall be as shown on the Plans. Clapper and spring check inlets shall each have a minimum capacity of 250 gpm, and be furnished with a cap and chain. Outlet shall be sized for simultaneous use of all inlets. Connection shall be branded “Building XX”.
1. 2-Way FDC: Connection shall conform to UL 405 or FM 1530. Elkhart, Croker, or approved equal.
2. 3-Way FDC: Connection shall be subject to approval by the local water department or fire marshal. Elkhart, Croker, Potter-Roemer or approved equal.
3. 4-Way FDC: Connection shall conform to UL 405. Potter-Roemer, Croker, or approved equal.
4. 6-Way FDC: Connection shall be subject to approval by the local water department or fire marshal. Croker, Potter-Roemer or approved equal.

2.20 FIRE HYDRANTS ***[CHECK WITH LOCAL AGENCY HAVING JURISDICTION FOR ACCEPTABLE HYDRANT MANUFACTURER(S) AND MODEL(S)]*****.**

A. Provide two 2 ½ inch and one 4 ½ inch outlets, with a 6 inch nominal inside diameter inlet and break-away type bolts. Hydrant shall have a working pressure of 250 psi and shall conform to AWWA C503, and be UL listed and FM approved. Provide hydrants of one manufacturer. Clow model 960 series or approved equivalent, subject to approval of the Owner and fire marshal.

2.21 THRUST BLOCKS

A. Use concrete conforming to ASTM C94 having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 ½ parts sand, and 5 parts gravel, having the same minimum compressive strength.

B. Provide thrust blocks or mechanical pipe restraints at all fittings and changes in angle, alignment or elevation.

C. Where depth or location of existing structures prohibit the use of standard thrust blocks, gravity blocks may be used.

2.22 TAPPING SLEEVES AND TAPPING VALVES

A. Tapping sleeves shall be epoxy coated and furnished with stainless steel washers, nuts and bolts. Mueller H-615 and H-619, Ford, or approved equal.

B. Tapping valves shall have flanged inlet, Class 150**,** conforming to ASME B16.1 and furnished with stainless steel washers, nuts and bolts. Tapping valves shall be constructed with a mechanical joint outlet. Mueller T-687, T-642, T-681, or approved equal.

2.23 SERVICE SADDLES AND CORPORATION STOPS

A. Service Saddles: Saddles shall conform to AWWA C800 and NSF 61.
   1. For DIP: Provide bronze or stainless steel body, double strap type with a 200 psi**,** maximum working pressure. Mueller BR2 Series, Ford, or approved equal.
   2. For PVC: Provide bronze body, wide strap type. Mueller H-13000 Series, Ford, or approved equal.
   3. For PE: Per manufacturer's recommendations.

B. Corporation Stops: Provide ground key type; bronze conforming to ASTM B61 or ASTM B62, for a working pressure of 100 psi and suitable for the working pressure of the system.
   1. Ends shall be suitable for adjoining pipe and connections, solder-joint, or flared tube compression type joint.
   2. Threaded ends shall conform to AWWA C800.
   3. Coupling nut for connection to flared copper tubing shall conform to ASME B16.26.
   4. Mueller H-15000 Series with "CC" threads and a copper flare straight connection outlet, Ford, or approved equal.

2.24 IDENTIFICATION MATERIALS AND DEVICES

A. Warning Tape: Provide warner tape consisting of metallic foil bonded to solid blue plastic film not less than 3 inches wide. Film shall be inert polyethylene plastic. Film and foil shall each not be less than 1 mil thick. The tape continuously shall have printed black-letter, not less than ¾ inch high, message reading "CAUTION: WATER MAIN BELOW".

B. Tracer Wire for Nonmetallic Piping: Provide 12 guage, coated copper or aluminum wire not less than 0.10 inch in diameter, with blue THW, THWN, or THHN rated

insulation, in sufficient length to be continuous over each separate run of nonmetallic pipe. Wire shall be tied in at all valves.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Pipe Depth and Trench Configuration: Conform to elevations, profiles and typical trench section(s) shown on the Plans.

B. Excavation, Bedding, Backfill, and Compaction: Section 31 21 00 – Utility Trenching and Backfill.

C. 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.

D. Pipe laying and jointing:

1. Provide proper facilities for lowering sections of pipe into trenches.
2. Do not drop or dump pipe, fittings, valves, or any other water line material into trenches.
3. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
4. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying.
5. Grade the pipeline in straight lines; avoid the formation of dips and low points.
6. Support pipe at proper elevation and grade.
7. Provide secure firm, uniform support. Wood support blocking will not be permitted.
8. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings.
9. Provide anchors and supports where indicated and where necessary for fastening work into place.
10. Make proper provision for expansion and contraction of pipelines.
11. Keep trenches free of water until joints have been properly made.
12. Do not lay pipe when conditions of trench or weather prevent proper installation.
13. All fittings shall be blocked with appropriately sized thrust blocks as shown on the Plans.

E. Installation of Tracer Wire:

1. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe.
2. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
3. Form a mechanically and electrically continuous line throughout the pipeline, extending to the nearest valve or other pipeline appurtenance. 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, terminate the 12 inch wire lead inside the enclosure.

4. 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.

F. Installation of Warning Tape
   1. Install tape approximately 1 foot above and along the centerline of the pipe.
   2. Where tape is not continuous, lap tape ends a minimum of 2 feet.

G. 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 manufacture for deflections at the joints or pipe bending.

H. Connections to Existing Lines:
   1. Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line.
   2. Make connections to existing lines under pressure in accordance with the recommended procedures of a manufacturer of pipe of which the line being tapped is made.

I. Closure: Close open ends of pipes and appurtenance openings at the end of each day's work or when work is not in progress.

3.2 INSTALLATION OF DUCTILE-IRON PIPING

A. Install pipe and fittings in accordance with requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

B. Jointing:
   1. Provide push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.
   2. Provide mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and with the recommendations of AWWA C111.
   3. Provide flanged joints with the gaskets, bolts, and nuts specified for this type joint.
   4. Install flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories.
   5. Align bolt holes for each flanged joint.
   6. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted.
   7. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without over straining the flange.
   8. Where flanged pipe and fitting have dimensions that do not allow the installation of a proper flanged joint as specified, replace it by one of proper dimensions.
   9. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe. Assemble in accordance with the recommendations of the setscrewed flange manufacturer.

10. Provide insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints. Bolts for insulating sleeves shall be full size for the bolt holes.
11. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

C. Exterior Protection: Completely encase buried ductile iron pipelines and underground appurtenances with polyethylene wrap. Install 8 mil linear low-density polyethylene (LLD) film or 4 mil high-density cross-laminated (HDCL) film per manufacturer's recommendations and in accordance with AWWA/ANSI C105/A21.5 and ASTM A674.

D. Pipe Anchorage: Provide concrete thrust blocks or restrained joints for pipe anchorage, except where metal harness is indicated on the Plans.

3.3 INSTALLATION OF POLYVINYL CHLORIDE PIPING

A. Comply with the recommendations for pipe installation, joint assembly and appurtenance installation in AWWA Manual M23.

B. Comply with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111.

C. Jointing:
1. Provide push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings.
2. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel.
3. For push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint.
4. Use an approved lubricant recommended by the pipe manufacturer for push-on joints.
5. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the applicable requirements of AWWA C600 for joint assembly.
6. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint. Cut off spigot end of pipe for compression-type joint or mechanical-joint connections and do not re-bevel.
7. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

D. Pipe Anchorage:
1. Provide concrete thrust blocks or restrained joints for pipe anchorage, except where metal harness is indicated on the Plans.

3.4 INSTALLATION OF VALVES

A. Gate Valves
   1. Install gate valves conforming to AWWA C500 and UL 262 in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix (Installation, operation, and Maintenance of Gate Valves) to AWWA C509.
   2. Install gate valves conforming to AWWA C509 in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix (Installation, Operation, and Maintenance of Gate Valves) to AWWA C509.
   3. Install gate valves on PVC water mains in addition in accordance with the recommendations for appurtenance installation in AWWA Manual M23.

B. Butterfly Valves: Install butterfly valves in accordance with the applicable requirements of Appendix A of AWWA C504.

C. Check Valves: Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation, except as otherwise indicated.

D. Joints:
   1. Valves on DI, PE and PVC Pipe: Mechanical joint valves for buried locations. Flanged-end valves for installation in vaults/pits.
   2. Valves on Steel Pipe: As indicated for buried locations. Flanged-end valves for installation in vaults/pits.

3.5 INSTALLATION OF VALVE AND METER BOXES

A. Boxes shall be centered over the appurtenance so as not to transmit shock or stress. Covers shall be set flush with the surface of the finished pavement, or as shown on the Plans. Backfill shall be placed around the boxes and compacted to the specified level in a manner that will not damage or displace the box from proper alignment or grade. Misaligned boxed shall be excavated, plumbed, and backfilled at no additional cost to the Owner.

3.6 INSTALLATION OF FIRE HYDRANTS

A. Install fire hydrants, except for metal harness, plumbed vertical, in accordance with AWWA C600 for hydrant installation and as indicated.

B. Provide and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Hydrants shall be set so that mounting bolts clear the top of finished grade by three inches so bolts may be easily replace if needed.

C. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which hydrant is attached.

3.7 SERVICE LINE CONNECTIONS TO WATER MAINS

A. Connect service lines of size shown on plans to the main with a rigid connection or a corporation stop and gooseneck. Install a gate valve on the service line.

B. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.

C. Connect service lines to PVC plastic water mains in accordance with the recommendations of AWWA Manual M23.

3.8 INSTALLATION OF BACKFLOW PREVENTERS

A. Backflow devices shall be installed horizontal and level, with three feet minimum clearances from obstructions.

3.9 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.

3.10 CONNECTION TO EXISTING

A. Contractor shall submit a work plan delineating the work sequence and duration of each task.

B. The Contractor to submit a contingency plan in case work extends beyond the allowable shutdown duration

C. The total allowed duration of shutdown shall not exceed ***xxx [enter duration]***. Any day exceeding this period will accrue liquidated damages of ***$XXX [enter amount]*** per day.

D. Contractor to notify Owner 48 hours prior to shutdown.

E. Prior to shutdown the Contractor shall have the following:
1. Approved submittals for the work to be done
2. Approved work plan
3. Approved contingency plan
4. The material, tools and equipment necessary to do the work, including pumps, generator, lighting, etc.

F. No work shall be done within two weeks from a wet weather event.

G. Contractor to check the weather (NOAA website) and plan work during dry weather period.

3.11 HYDROSTATIC PRESSURE AND LEAKAGE TEST

A. General:
1. Provide all necessary materials and equipment, including water.
2. Backfill all trenches sufficient to hold pipe firmly in position.

3. Allow time for thrust blocks to cure prior to testing.
4. Flush all pipes prior to testing to remove all foreign material.
5. Perform pressure and leakage test concurrently.
6. Apply test pressure by means of a pump connected to the pipe.
7. Base test pressure on the elevation of the lowest point in the line.
8. 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.
9. Ensure the release of air from the line during filling, and prevent collapse due to vacuum when dewatering the line.
10. The pressure test on mortar-lined pipe shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption in the cement mortar lining.
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.
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. Preparation for Test
1. Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.
2. Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc. that shall not be subjected to the test pressure.
3. All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.
4. Connect pump and provide temporary closures for all of the external openings in the system. Use caution to insure that the closures are properly designed and strong enough to withstand the test pressure.
5. A joint previously tested in accordance with this specification may be covered or insulated.
6. Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.
7. Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.

C. DIP Leakage Test: Perform in accordance with AWWA C600. Selected requirements of AWWA C600 are repeated as follows:
1. The pipe shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure, or 150 psi, whichever is greater. In no case shall the pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.
2. Maintain the test pressure, +/- 5 psi, for a minimum of four hours.

3. No piping will be accepted if the leakage is greater than that determined by the following formula:

   L = (S x D x P1/2)/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).

D. PVC Pipe Leakage Test: Perform in accordance with AWWA M23. Selected requirements of AWWA M23 are repeated as follows:

1. The pipe shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure, or 150 psi, whichever is greater. In no case shall the pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.
2. Maintain the test pressure, +/- 5 psi, for a minimum of four hours.
3. No piping will be accepted if the leakage is greater than that determined by the following formula:

   L = (N x D x P1/2)/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).

3.12 CLEANING

A. At the conclusion of the work, thoroughly clean all pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning, obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Owner will examine the pipes for leaks. If any further defective pipes or joints are discovered, the Contractor shall repair them. Finished paving shall not be installed prior to completion of all cleaning and testing.

3.13 DISINFECTION OF PIPELINES

A. After completion of the hydrostatic test, the mains shall be thoroughly flushed with a minimum pipe velocity of 2.5 fps and chlorinated in accordance with the latest revision of AWWA 651, Standards of Disinfecting Water Mains. Any one of the methods therein described may be used, with the additional requirement of 50 ppm chlorination minimum initial application. At the end of the contact period, the mains shall again be flushed, and bacteriological samples taken.

B. If necessary, the Contractor shall provide, at his expense, outlets from which to take the samples. The location of the chlorination and sampling points will be determined by the Owner in the field. Taps for chlorination and sampling shall be installed. The Contractor shall uncover and backfill the taps as required.

C. Disinfection of tie-ins shall be performed by the Contractor by swabbing with chlorine or by other approved methods. Following a tie-in, the area affected by the tie-in shall be thoroughly flushed and bacteriological samples will be taken as deemed necessary.

D. All treated water flushed from the lines shall be dechlorinated and disposed of by discharging to the locations identified in the Plans, or by other approved means. No discharge of chlorinated water to any storm sewer or natural water course will be allowed, unless properly dechlorinated.

E. The Contractor shall rechlorinate and retest any lines that do not meet the requirements of the above testing. The line shall not be placed in service until the requirements of the State Public Health Department are met.

3.14 BACTERIOLOGICAL TESTING

A. Samples shall be gathered and tests conducted at the expense of the Contractor by a laboratory approved by the Owner.

B. Water samples are to be taken at representative points no less than one test per 500 feet of pipe, plus one test at each end of the pipe; or as required by the Owner.

C. After the samples have passed the bacteriological testing, the Contractor will be notified and arrangements can be made to make tie-ins and connections to house services.

D. Each water sample will have passed the bacteria tests if they show zero total coliform per 100 ml and not more than 50 non-sheen bacteria per 100 ml, and when the turbidity is no greater than the source water.

E. Samples shall be taken no sooner than 24 hours after final flushing.

F. Jumpers and/or plates shall be pulled within 14 days of the notification of a successful test, or new bacteria samples will have to be taken.

G. Follow-up bacteriological testing shall take place after tie-ins have been made, and shall meet the same passing requirements as the initial tests.

END OF SECTION

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SECTION 33 30 00

SANITARY SEWER SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary gravity sewers and force mains up to five feet from any on-site building

1.2 RELATED SECTIONS

A. Section 31 21 00, Utility Trenching and Backfill

B. Section 32 13 18, Cement and Concrete for Exterior Improvements

1.3 RELATED DOCUMENTS

A. AASHTO
1. M199: Standard Specification for Precast Reinforced Concrete Manhole Sections
2. M252: Standard Specification for Corrugated Polyethylene Drainage Pipe
3. M294: Standard Specification for Corrugated Polyethylene Pipe, 12 to 60 inch Diameter

B. ASTM
1. A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
2. ASTM A674: Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
3. C143: Standard Test Method for Slump of Hydraulic-Cement Concrete
4. C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
5. C478: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
6. C923: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
7. C1173: Standard Specification for Flexible Transition Couplings for Underground Piping Systems
8. C1244: Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
9. D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications
10. D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
11. D4101: Standard Specification for Propylene Injection and Extrusion Materials
12. F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
13. F679: Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings

14. ASTM F1056: Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings
15. F1336: Standard Specification for Poly(Vinyl Chloride) (PVC) Gasket Sewer Fittings

C. AWWA
1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C110: Ductile-Iron and Gray-Iron Fittings
4. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. C115: Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
6. C116: Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
7. C150: Thickness design of Ductile Iron Pipe
8. C151: Ductile-Iron Pipe, Centrifugally Cast
9. C153: Ductile-Iron Compact Fittings
10. C219: Bolted, Sleeve-type Couplings for Plain-End Pipe
11. C512: Air Release , Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
12. C600: Installation of Ductile-Iron Water Mains and Their Appurtenances.
13. C606: Grooved and Shouldered Joints
14. C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. for Water Transmission and Distribution
15. C905: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. for Water Transmission and Distribution
16. C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. for Waterworks
17. M23: PVC Pipe – Design and Installation
18. M41: Ductile Iron Pipe and Fittings

D. Caltrans Standard Specifications, 2015
1. Section 51, Concrete Structures
2. Section 65, Concrete Pipe
3. Section 75 Miscellaneous Metal
4. Section 90, Concrete

E. Federal Specification
1. SS-S-00210 (GSA-FSS)

1.4 DEFINITIONS

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

B. ASTM: American Society for Testing Materials

C. AWWA: American Water Works Association

D. HDPE: High-density polyethylene

E. PE: Polyethylene

F. DIP: Ductile iron pipe

G. PVC: Polyvinyl Chloride

H. RCP: Reinforced concrete pipe

I. NPS: Nominal pipe size

1.5 SUBMITTALS [EDIT SUBMITTAL LIST PER MATERIAL ON THE JOB]

A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.

B. Product data for the following:
1. Piping materials and fittings
2. Special pipe couplings
3. Joint sealants
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 test results for compliance with performance.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage
1. Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

B. Handling
1. Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. When handling lined pipe, take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.
2. Handle precast concrete pipe, manholes and other precast structures according to manufacturer's written instructions.
3. Protect imported bedding and backfill material from contamination by other materials.

PART 2 - PRODUCTS

2.1 PVC PIPE

A. Pipe:
   1. 4 inch through 15 inch: ASTM D3034, SDR 26
   2. 18 inch through 36 inch: ASTM F679, T-1 wall

B. Bell and spigot joints

C. Fittings:
   1. 4 inch through 27 inch: ASTM F1336
   2. 30 inch through 36 inch: ASTM D3034, SDR 26

D. Joint Gasket: Elastomeric seal, ASTM F477

E. Special Pipe Coupling: ASTM C1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.

2.2 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:
   1. Non-Traffic Areas: Portland cement concrete box and box cover, light duty
   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: “SANITARY SEWER” 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.
   2. Brooks Products Inc.
   3. Christy Concrete Products, Inc., or approved equal

2.3 MANHOLES

A. Manholes shall be pre-cast concrete of the size and shape shown on the Plans and shall conform to ASTM C478. Equivalent poured-in-place structures may be used at the Contractor’s option. Concrete shall consist of Caltrans Type I/II cement. Rate for AASHTO H20 loading in traffic areas.

B. All interior concrete surfaces shall be coated with “Xypex Crystalline” or approved equivalent. Use of a water-resistant admix is acceptable, at Contractor option.

C. Frames and Covers: As indicated and in accordance with Caltrans Standard Specification Section 75-2.02B. Manhole covers shall have the words “SANITARY SEWER” in letters not less than 2 inches cast into the cover. The clear opening for all manhole covers shall be 24 inches.

D. Frames and lids for manholes shall be match-marked in pairs before delivery to the job site. The lids shall fit into their frames without rocking.

E. Reinforcing Bars: Reinforcing bars shall be of intermediate grade billet steel conforming to ASTM A615 and shall be of the size shown on the Standard Details or in the Plans. Bars shall be of the round deformed type, free from injurious seams, flaws, or cracks, and shall be cleaned of all rust, dirt, grease and loose scales.

F. Portland Cement Concrete: Concrete for manhole bases, inlets, and other concrete structures shall conform to the requirements of Caltrans Standard Specifications Section 90 and as specified herein. The concrete shall be Class “A” containing six (6) sacks of portland cement per cubic yard of concrete. The grading of the combined aggregate shall be in accordance with the Caltrans requirements of the three-quarter inch maximum. The consistency of the concrete shall be such that the slump does not exceed four inches, as determined by ASTM C143. The concrete shall have a minimum design compressive strength of 3,000 psi after 28 days.

G. Steps: ASTM C478 or AASHTO M199. Manufacture from deformed, ½ inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, or equal.

2.4 JOINT SEALANT FOR STRUCTURES AND MANHOLES

A. Mortar: Caltrans Standard Specification Section 51-1.02F
   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
   1. Rubber Gaskets: ASTM C443
   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 Henry Company, or equal

2.5 PIPE TO STRUCTURE CONNECTOR/SEAL

A. A flexible pipe to manhole connector shall be used for all pipe penetrations to pre-cast and/or cast-in-place concrete structures.
   1. The seal shall provide a flexible, positive, watertight connection between pipe and concrete wastewater structures. The connector shall assure that a seal is made between (1) the connector and the structure wall, and (2) between the connector and the pipe. The seal between the connector and the manhole wall shall be made by casting the connector integrally with the structure wall during the manufacturing process in such a manner that it will not pull out during coupling. The seal between connector and pipe will be

made by way of a stainless steel take down band compressing the gasket against the outside diameter of the pipe.

2. The connector shall be molded from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outlined in ASTM C923. The connector and stainless steel hardware shall meet or exceed the performance requirements proscribed in ASTM C923.
3. The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with recommendations of the manufacturer.
4. Connectors shall be Z-LOK or G3 connectors manufactured by A-LOK Products Inc. or approved equivalent.

2.6 SEWAGE AIR RELIEF VALVE ASSEMBLY FOR FORCE MAINS

A. Air release and vacuum valves: Provide valve and service size as shown on the Plans. Valve shall have cast-iron single valve body, and shall conform to AWWA C512. A compound lever system shall have a maximum operating pressure of 300 psi. Provide a protective cap for the outlet of the valve. Provide universal air-vacuum type valves, Crispin, DeZurik/APCO or approved equal.

2.7 THRUST BLOCKS FOR FORCE MAINS

A. General: Location and configuration as indicated

B. Portland Cement Concrete: Section 32 13 18, Cement and Concrete for Exterior Improvements

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 65-2.03 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 31 21 00, Utility Trenching and Backfill.

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 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. 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 day's work or when work is not in progress.

3.2 INSTALLATION OF POLYVINYL CHLORIDE PIPING

A. Comply with the recommendations for pipe installation, joint assembly and appurtenance installation in AWWA M23.

B. Comply with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111.

C. Jointing:
1. Provide push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings.
2. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel.
3. For push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint.
4. Use an approved lubricant recommended by the pipe manufacturer for push-on joints.
5. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the applicable requirements of AWWA C600 for joint assembly.
6. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint. Cut off spigot end of pipe for compression-type joint or mechanical-joint connections and do not re-bevel.
7. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

D. Pipe Anchorage:
1. Provide concrete thrust blocks or restrained joints for pipe anchorage, except where metal harness is indicated 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: Manufacturers' instructions

3.4 GRAVITY PIPELINE AIR TESTING AND FLUSHING

A. All new sections of sanitary sewer shall be tested using the following procedures:

1. Test is conducted between two consecutive manholes, or as directed by the Project Manager.
2. The test section of the sewer shall be plugged at each end. One of the plugs used at the manhole shall be tapped and equipped for the air inlet connection for filling the line from an air compressor.
3. All service laterals, stubs, and fittings into the sewer test section shall be properly capped or plugged and carefully braced against the internal pressure to prevent air leakage by slippage and blowout.
4. Connect air hose to tapped plug selected for the air inlet. Connect the other end of the air hose to the portable air control equipment, which consists of valves and pressure gauges used to control the air entry rate into the sewer test section, and to monitor the air pressure in the pipeline. More specifically, the air control equipment includes a shut-off valve, pressure regulating valve, pressure reduction valve, and a monitoring pressure gauge having a pressure range from 0-5 psi. The gauge shall have minimum divisions of 0.10 psi and an accuracy of 0.40 psi.
5. Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment set-up. Test operations may commence.
6. Supply air to the test section slowly, filling the pipeline until a constant pressure of 3.5 psig is maintained. The air pressure must be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig.
7. When constant pressure of 3.5 psig is reached, throttle the air supply to maintain the internal pressure above 3.0 psig for at least 5 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, it is advisable to check all capped and plugged fittings with a soap solution to detect any leakage at these connections. If leakage is detected at any cap plug, release the pressure in the line and tighten all leaky caps and plugs. Start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug, a new 5-minute interval must be allowed after the pipeline has been refilled.
8. After the stabilization period, adjust the air pressure to 3.5 psig and shut-off or disconnect the air supply. Observe the gauge until the air pressure reached 3.0 psig. At 3.0 psig, commence timing with a stopwatch until the pressure drops to 2.5 psig, at which time the stop watch is stopped. The time required, as shown on the stopwatch, for a pressure loss of 0.5 psig is used to compute the air loss.
9. If the time, in minutes and seconds, for the air pressure drop from 3.0 to 2.5 psi is greater than that shown in the following table for the designated pipe size, the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued at any time.
10. If the time, in minutes and seconds, for the 0.5 psig drop is less than that shown in the following table for the designated pipe size, the section of the pipe shall not have passed the test; therefore, adequate repairs must be made and the line retested.

Requirements for Air Testing

Pipe Size (in inches)	Time Minutes	Seconds
4	2	32
6	3	50
8	5	6
10	6	22
12	7	39
14	8	56
15	9	35
16	10	12
18	11	34
20	12	30

11. For 8 inch and smaller pipe, only: if, during the 5 minute saturation period, pressure drops less than 0.5 psig after the initial pressurization and air is not added, the pipe section undergoing test shall have passed.
12. Multi-pipe sizes: when the sewer line undergoing test is 8 inch or larger diameter pipe and includes 4 inch or 6 inch laterals, the figures in the table for uniform sewer main sizes will not give reliable or accurate criteria for the test. Where multi-pipe sizes are to undergo the air test, the Project Manager can compute the “average” size in inches which is then multiplied by 38.2 seconds. The results will give the minimum time in seconds acceptable for a pressure drop of 0.5 psig for the “averaged” diameter pipe.
13. Adjustment Required for Groundwater:
    a. An air pressure correction is required when the ground water table is above the sewer line being tested. Under this condition, the air test pressure must be increased .433 psi for each foot the ground water level is above the invert of the pipe.
    b. Where ground water is encountered or is anticipated to be above the sewer pipe before the air testing will be conducted, the following procedure shall be implemented at the time the sewer main and manholes are constructed.
        1. Install a ½ inch diameter pipe nipple (threaded one or both ends, approximately 10 inch long) through the manhole wall directly on top of one of the sewer pipes entering the manhole with threaded end of nipple extending inside the manhole.
        2. Seal pipe nipple with a threaded ½ inch cap.
        3. Immediately before air testing, determine the ground water level by removing the threaded cap from the nipple, blowing air through the pipe nipple to remove any obstruction, and then connecting a clear plastic tube to the pipe nipple.
        4. Hold plastic tube vertically permitting water to rise in it to the groundwater level.
        5. After water level has stabilized in plastic tube, measure vertical height of water, in feet, above invert of sewer pipe.
        6. Determine air pressure correction, which must be added to the 3.0 psig normal starting pressure of test, by dividing the vertical height in feet by 2.31. The result gives the air pressure correction in pounds per square inch to be added.

B. After the line has passed the air test, it shall be balled and flushed with water to clean. A metal screen shall be used downstream at the point of connection to the

existing system to collect and remove any rock or other debris that is flushed out during cleaning.

3.5 TESTING OF MANHOLES ON GRAVITY LINES

A. At the option of the Contractor, either the following hydrostatic or vacuum test shall be performed.
   1. Hydrostatic Test: In general, the following hydrostatic test is in conformance with that presented in the city of South San Francisco Standard Specifications.
   2. Insert inflatable plugs in all sewer inlets and outlets.
   3. Fill the manhole with water to a point six inches below the base of the manhole frame.
   4. Maintain the water at this point for one hour to allow time for absorption.
   5. 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.
   6. Determine the allowable leakage by the following formula.

      L = 0.0002 x D x H1/2

      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.

   7. 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.

B. Vacuum Test:
   1. General: Test in accordance with ASTM C1244.
   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 manufacturer’s 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 inch 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.

3.6 HYDROSTATIC AND LEAKAGE TESTING OF FORCE MAINS

A. General:
   1. Provide all necessary materials and equipment, including water.
   2. Backfill all trenches sufficient to hold pipe firmly in position.

3. Allow time for thrust blocks to cure prior to testing.
4. Flush all pipes prior to testing to remove all foreign material.
5. Perform pressure and leakage test concurrently.
6. Apply test pressure by means of a pump connected to the pipe.
7. Base test pressure on the elevation of the lowest point in the line.
8. 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.
9. Ensure the release of air from the line during filling, and prevent collapse due to vacuum when dewatering the line.
10. The pressure test on mortar-lined pipe shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption in the cement mortar lining.
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.
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.
16. Preparation for Test
17. Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.
18. Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc. that shall not be subjected to the test pressure.
19. All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.
20. Connect pump and provide temporary closures for all of the external openings in the system. Use caution to insure that the closures are properly designed and strong enough to withstand the test pressure.
21. A joint previously tested in accordance with this specification may be covered or insulated.
22. Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.
23. Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.

B. DIP Leakage Test: Perform in accordance with AWWA C600. Selected requirements of AWWA C600 are repeated as follows:
1. The pipe shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure, or 150 psi, whichever is greater. In no case shall the pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.
2. Maintain the test pressure, +/- 5 psi, for a minimum of four hours.
3. No piping will be accepted if the leakage is greater than that determined by the following formula:

L = (S x D x P1/2)/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:

1. The pipe shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure, or 150 psi, whichever is greater. In no case shall the pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.
2. 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.
3. After the above stabilization has occurred, return the section being tested to the test pressure. Hold the test pressure for four 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 (in.)	Allowance for Expansion (U.S. Gals./100 Feet of Pipe)		
	1-Hour Test	2-Hour Test	3-Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.50
10	0.75	1.3	2.1
11	1.0	2.0	3.0
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3
28	5.5	11.1	16.8
32	7.0	14.3	21.5
36	9.0	18.0	27.0
40	11.0	22.0	33.0
48	15.0	27.0	43.0

D. PVC Pipe Leakage Test: Perform in accordance with AWWA M23. Selected requirements of AWWA M23 are repeated as follows:

1. The pipe shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure, or 150 psi, whichever is greater. In no case shall the pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.
2. Maintain the test pressure, +/- 5 psi, for a minimum of four hours.
3. No piping will be accepted if the leakage is greater than that determined by the following formula:

   L = (N x D x P1/2)/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).

3.7 DEFLECTION TESTING

A. Upon completion of work, perform a deflection test on entire length of installed plastic pipeline. Completed work includes superimposed loads adjacent to and over the pipeline, such as compacted backfill and earthwork, and does not include paving, concrete curbs and gutters, sidewalks, walkways, and landscaping.

B. Under external loads, deflection of pipe in the installed pipeline shall not exceed 4.5 percent of the average inside diameter of pipe.

C. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection-measuring device.

D. Pull-Through Device:

1. Provide a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft.
   a. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section.
   b. Pull-through device may also be of a design approved by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device.
2. Ball, cylinder, or circular sections shall conform to the following:
   a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
   b. A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.
   c. Center bored and through bolted with a ¼ inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.

d. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

E. Pull-Through Device:
1. Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water.
2. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

F. Deflection measuring Device:
1. Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension.
2. Obtain approval of deflection measuring device prior to use.

G. Deflection Measuring Device Procedure:
1. Measure deflections through each run of installed pipe.
2. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction.
3. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflections, replace with new pipe, and completely retest in same manner and under same conditions.

H. Warranty Period Test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of 1 year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.8 CLEANING

A. Thoroughly clean sewer lines and manholes of sediments, dirt, debris, and obstructions of any kind.

3.9 TELEVISION INSPECTION

A. After completion of the pipe installation, service connections, flushing and cleaning, and prior to placement of pavement, the sewer line shall be televised with a color closed-circuit television with tilt-head camera recorded in DVD format. The original disc and log sheets shall be provided to the Owner for review.

B. The following observations from television inspections will be considered defects in the construction of sewer pipelines and will require correction prior to placement of pavement:
1. Low spot (1 inch or greater - mainlines only)
2. Joint separations (3/4 inch or greater opening between pipe sections)
3. Cocked joints present in straight runs or on the wrong side of pipe curves
4. Chips in pipe ends
5. Cracked or damaged pipe
6. Dropped joints
7. Infiltration

8. Debris or other foreign objects
9. Other obvious deficiencies
10. Irregular condition without logical explanation

END OF SECTION

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SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roadway and/or site storm drainage system up to five feet of any on-site building

1.2 RELATED SECTIONS

A. Section 31 21 00, Utility Trenching and Backfill

B. Section 32 13 18, Cement and Concrete for Exterior Improvements

1.3 RELATED DOCUMENTS

A. AASHTO
1. M199: Precast Reinforced Concrete Manhole Sections
2. M252: Corrugated Polyethylene Drainage Pipe
3. M294: Corrugated Polyethylene Pipe, 12 to 604 inch Diameter

B. ASTM
1. A74: Cast Iron Soil Pipe and Fittings
2. A615: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
3. C143: Standard Test Method for Slump of Hydraulic-Cement Concrete
4. C443: Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
5. C478: Circular Precast Reinforced Concrete Manhole Sections
6. C564: Rubber Gaskets for Cast Iron Soil Pipe and Fittings
7. C923: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
8. C1173: Flexible Transition Couplings for Underground Piping Systems
9. D1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
10. D2321: Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications
11. D2564: Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
12. D3034: Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
13. D4101: Propylene Injection and Extrusion Materials
14. F477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe
15. F656: Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
16. F679: Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
17. F1336: Poly(Vinyl Chloride) (PVC) Gasket Sewer Fittings

C. AWWA
1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems

3. C110: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. for Water
4. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. C115: Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
6. C116: Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
7. C150: Thickness design of Ductile Iron Pipe
8. C151: Ductile-Iron Pipe, Centrifugally Cast
9. C153: Ductile-Iron Compact Fittings
10. C219: Bolted, Sleeve-type Couplings for Plain-End Pipe
11. M41: Ductile Iron Pipe and Fittings

D. Caltrans Standard Specifications, 2015
1. Section 51, Concrete Structures
2. Section 52, Reinforcement
3. Section 65, Concrete Pipe
4. Section 66, Corrugated Metal Pipe
5. Section 70, Miscellaneous Drainage Facilities
6. Section 72, Slope Protection
7. Section 75, Miscellaneous Metal
8. Section 90, Concrete

E. Caltrans Standard Plans, 2015
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 D97C: Corrugated Metal Pipe Coupling Details No. 3, Helical and Universal Couplers
5. Plan D97D: Corrugated Metal Pipe Coupling Details No. 4, Hugger Coupling Bands
6. Plan D97E: Corrugated Metal Pipe Coupling Details No. 5, Standard Joint
7. Plan D97F: Corrugated Metal Pipe Coupling Details No. 6, Positive Joint
8. Plan D97G: Corrugated Metal Pipe Coupling Details No. 7, Downdrain
9. Plan D98A: Slotted Corrugated Steel Pipe Drain Details
10. Plan D98B: Slotted Corrugated Steel Pipe Drain Details

1.4 DEFINITIONS

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

B. ASTM: American Society for Testing Materials

C. AWWA: American Water Works Association

D. CMP: Corrugated metal pipe

E. DIP: Ductile iron pipe

F. HDPE: High-density polyethylene

G. NPS: Nominal pipe size

H. PE: Polyethylene

I. PVC: Polyvinyl Chloride

J. RCP: Reinforced concrete pipe

1.5 SUBMITTALS

A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.

B. Product data 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

C. Shop drawings: Include plans, elevations, details and attachments for the following:
1. Precast concrete manholes, frames and covers

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. Delivery and Storage
1. Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

B. Handling
1. Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. When handling lined pipe, take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

2. Handle precast concrete pipe, manholes and other precast structures according to manufacturer's written instructions.
3. Protect imported bedding and backfill material from contamination by other materials.

PART 2 - PRODUCTS

2.1 CORRUGATED METAL PIPE AND FITTINGS:

A. CMP pipe shall be in accordance to Caltrans Standard Specification Section 66

B. Bituminous Coating: Caltrans Standard Specification Section 66-1.02C

C. Bituminous Lining: Caltrans Standard Specification Section 66-1.02C

D. Bituminous Paving: Caltrans Standard Specification Section 66-1.02C

E. Corrugated Aluminum Pipe: Caltrans Standard Specification Section 66-1.02F

F. Corrugated Steel Pipe: Caltrans Standard Specification Section 66-1.02E

G. Slotted Corrugated Steel Pipe: Caltrans Standard Specification Section 66-2

H. Details: Caltrans Standard Plans D97A, D97C, D97D, D97E, D97F, D97G, D98A and D98B

2.2 PE PIPE AND FITTINGS (HDPE): 12 INCH THROUGH 48 INCH

A. Pipe shall be in accordance to AASHTO M294. Type S, smooth interior and corrugated exterior.

B. Bell and spigot joints

C. Bell and Spigot Joint Gasket: Elastomeric seal, ASTM F477

D. Couplings: AASHTO M252, corrugated band type, engage a minimum of 4 corrugations, 2 on each side of pipe joint

2.3 PVC PIPE AND FITTINGS-SMALLER THAN 4 INCH

A. Pipe shall be in accordance to ASTM D1785, Schedule 40.

B. Joints: Solvent Cement, ASTM D2564

C. Include primer according to ASTM F656

D. Special Pipe Coupling: ASTM C1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.

2.4 PVC PIPE, 4 INCH AND LARGER

A. Pipe

1. 4 inch through 15 inch: ASTM D3034, SDR 35
2. 18 inch through 36 inch: ASTM F679, T-1 wall

B. Bell and spigot joints

C. Fittings:
1. 4 inch through 27 inch: ASTM F1336
2. 30 inch through 36 inch: ASTM D3034, SDR 35

D. Joint Gasket: Elastomeric seal, ASTM F477

E. Special Pipe Coupling: ASTM C 1173. Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined

2.5 REINFORCED CONCRETE PIPE

A. Designated by Class, rubber gasketed joints, Type II or V cement
1. Circular Reinforced Concrete Pipe: Caltrans Standard Specification Section 65-2.02C(2). Class III

B. Rubber Gasketed Joints: Caltrans Standard Specification Section 65-2.02F

C. Special Pipe Couplings: Portland cement collar as indicated

2.6 PIPE ANCHORS

A. General: Location, configuration bearing area, etc. as indicated

B. Portland Cement Concrete: Section 32 13 18, Cement and Concrete for Exterior Improvements

2.7 PIPE 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 cap

D. Box Types
1. Non-Traffic Areas: Portland cement concrete box and box cover, light duty
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.
2. Brooks Products Inc.
3. OldCastle Precast/Christy Concrete Products, Inc.

2.8 AREA DRAINS

A. Grate and Riser: Area drain shall be as manufactured by Nyloplast or approved equal. Riser shall be constructed of 6 inch PVC SDR 35 piping per paragraph 2.1(A) of this section and connected to area drain by a gasket joint. Riser shall be vertical except as otherwise noted in the plans. Riser may include a reducer if necessary to make connection to the storm drain line.

B. Elevation and Grading: Area Drain rim elevation shall be set and area around area drain shall be graded to drain away from any adjacent structures, walks, or roadways and towards area drain.

2.9 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 32 13 18, Cement and Concrete for Exterior Improvements.

C. Precast Structure: Rate for AASHTO H20 loading in traffic areas.

D. Steps: ASTM C 478 or AASHTO M199. Manufacture from deformed, ½ inch steel reinforcement rod complying with ASTM A615 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, 75-1.02.B and 75-2
   1. Galvanize steel frames, grates and covers
   2. Grates and covers shall be non-rocking
   3. Rate for AASHTO H20 loading in traffic areas

2.10 MANHOLES

A. Manholes shall be pre-cast concrete of the size and shape shown on the Plans and shall conform to ASTM C478. Equivalent poured-in-place structures may be used at the Contractor's option. Concrete shall consist of Caltrans Type I/II cement. Rate for AASHTO H20 loading in traffic areas.

B. All interior concrete surfaces shall be coated with "Xypex Crystalline" or approved equivalent. Use of a water-resistant admix is acceptable, at Contractor option.

C. Frames and Covers: As indicated and in accordance with Caltrans Standard Specification Section 75-2.02B. Manhole covers shall have the words "STORM

DRAIN" in letters not less than 2 inches cast into the cover. The clear opening for all manhole covers shall be 24 inches.

D. Frames and lids for manholes shall be match-marked in pairs before delivery to the job site. The lids shall fit into their frames without rocking.

E. Reinforcing Bars: Reinforcing bars shall be of intermediate grade billet steel conforming to ASTM A615 and shall be of the size shown on the Standard Details or in the Plans. Bars shall be of the round deformed type, free from injurious seams, flaws, or cracks, and shall be cleaned of all rust, dirt, grease and loose scales.

F. Portland Cement Concrete: Concrete for manhole bases, inlets, and other concrete structures shall conform to the requirements of Caltrans Standard Specifications Section 90 and as herein specified. The concrete shall be Class "A" containing six (6) sacks of portland cement per cubic yard of concrete. The grading of the combined aggregate shall conform with the CDT requirements of the three-quarter inch maximum. The consistency of the fresh aggregate shall be such that the slump does not exceed four inches, as determined by ASTM C143. The concrete shall have a minimum design compressive strength of 3,000 psi after 28 days.

G. Steps: ASTM C478 or AASHTO M199. Manufacture from deformed, ½ inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Acceptable manufacturer is Hanson Concrete Products, or approved equal.

2.11 JOINT SEALANT FOR PRECAST STRUCTURES AND MANHOLES

A. Mortar: Caltrans Standard Specification Section 51-1.02F
   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
   1. Rubber Gaskets: ASTM C443
   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 Henry Company, or approved equal.

2.12 PIPE TO STRUCTURE CONNECTOR/SEAL

A. A flexible pipe to manhole connector shall be used for all pipe penetrations to pre-cast and/or cast-in-place concrete structures.
   1. The seal shall provide a flexible, positive, watertight connection between pipe and concrete wastewater structures. The connector shall assure that a seal is made between (1) the connector and the structure wall, and (2) between the connector and the pipe. The seal between the connector and the manhole wall shall be made by casting the connector integrally with the structure wall during the manufacturing process in such a manner that it will not pull out during coupling. The seal between connector and pipe will be made by way of a stainless steel take down band compressing the gasket against the outside diameter of the pipe.
   2. The connector shall be molded from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outlined

in ASTM C923. The connector and stainless steel hardware shall meet or exceed the performance requirements proscribed in ASTM C923.

3. The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with recommendations of the manufacturer.
4. Connectors shall be Z-LOK or G3 connectors manufactured by A-LOK Products Inc. or approved equivalent.

2.13 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.
2. "ACO Drain" by ACO Polymer Products Inc. , or approved equal

2.14 METAL, CONCRETE OR PLASTIC FLARED END SECTIONS

A. General: Caltrans Standard Specification Section 70-5.02 and Caltrans Standard Plan D94A and D94B

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 65-2.03 for reinforced concrete pipe, Caltrans Standard Specification Section 66-1.03 for 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 31 21 00, Utility Trenching and Backfill

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 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. 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 day's work or when work is not in progress.

3.2 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

3.3 INSTALLATION OF CURB INLETS, CATCH BASINS, DROP INLETS, JUNCTION STRUCTURES, AREA DRAINS, ETC. AND MANHOLES

A. Excavation, Bedding, Backfill, and Compaction: Section 31 21 00, Utility Trenching and Backfill

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.

3.4 POLYMER-CONCRETE TRENCH DRAIN INSTALLATION

A. Excavation, Bedding, Backfill, and Compaction: Section 31 21 00, Utility Trenching and Backfill

B. Install: As indicated and in accordance with the manufacturer's instructions.

3.5 POURED-IN-PLACE CONCRETE

A. Concrete shall be mixed in accordance with applicable provisions of Section 90 of Caltrans Standard Specifications.

B. Construction of concrete structures shall conform to applicable provisions of Section 51 of the Caltrans Standards Specifications. Unless otherwise noted herein or in the Plans, exposed surfaces of structures shall be Class 1 surface finish.

C. Curing shall conform to applicable portions in Section 90 of Caltrans Standard Specifications. No pigment shall be used in curing compounds. All work shall be subject to inspection. No concrete shall be placed until the Project Manager has approved the forms and reinforcement.

D. Concrete shall not be cropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six feet. Spouts, elephant trunks, or other approved means shall be used to prevent segregation.

3.6 PIPELINE FLUSHING

A. Newly constructed storm drain pipes shall be flushed with water to clean. A metal screen shall be used to collect and remove any rock, silt and other debris that is flushed out during cleaning.

3.7 DEFLECTION TESTING

A. Upon completion of work, perform a deflection test on entire length of installed plastic pipeline. Completed work includes superimposed loads adjacent to and over the pipeline, such as compacted backfill and earthwork, and does not include paving, concrete curbs and gutters, sidewalks, walkways, and landscaping.

B. Under external loads, deflection of pipe in the installed pipeline shall not exceed 4.5 percent of the average inside diameter of pipe.

C. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection-measuring device.

D. Pull-Through Device:

1. Provide a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft.
    a. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section.
    b. Pull-through device may also be of a design approved by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device.
2. Ball, cylinder, or circular sections shall conform to the following:
    a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

b. A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

c. Center bored and through bolted with a ¼ inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.

d. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

3. Pull-Through Device:

a. Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water.

b. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

E. Deflection measuring Device:

1. Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension.

2. Obtain approval of deflection measuring device prior to use.

F. Deflection Measuring Device Procedure:

1. Measure deflections through each run of installed pipe.

2. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction.

3. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflections, replace with new pipe, and completely retest in same manner and under same conditions.

G. Warranty Period Test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of 1 year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.8 CLEANING

A. Thoroughly clean storm drain lines, manholes, catch basins, field inlets, culverts, and similar structures, of dirt, debris, and obstructions of any kind.

3.9 TELEVISION INSPECTION

A. After completion of the pipe installation, service connections, flushing and cleaning, and prior to placement of pavement, the drain line shall be televised with a color closed-circuit television with tilt-head camera recorded in DVD format. The original disc and log sheets shall be provided to the Owner for review.

B. The following observations from television inspections will be considered defects in the construction of sewer pipelines and will require correction prior to placement of pavement:

1. Low spot (1 inch or greater - mainlines only)
2. Joint separations (3/4 inch or greater opening between pipe sections)
3. Cocked joints present in straight runs or on the wrong side of pipe curves.
4. Chips in pipe ends
5. Cracked or damaged pipe
6. Dropped joints
7. Infiltration
8. Debris or other foreign objects
9. Other obvious deficiencies
10. Irregular condition without logical explanation

END OF SECTION

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SECTION 33 46 00

SUBDRAINAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Subdrains in trenches and subdrains or prefabricated composite drainage panels at walls or foundations

B. Bioretention and biofiltration areas for storm water treatment

1.2 RELATED SECTIONS

A. Section 31 23 33, Utility Trenching and Backfill

B. Section 33 41 00, Storm Utility Drainage Piping

1.3 RELATED DOCUMENTS

A. Geotechnical Report: ***[Insert Report Title, Company, and Report Date]***.

B. AASHTO
1. M288: Standard Specification for Geotextiles Used for Subsurface Drainage Purposes

C. ASTM
1. C1173: Standard Specification for Flexible Transition Couplings for Underground Piping Systems
2. D448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction
3. D1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics
4. D1785: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
5. D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
6. D2564: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
7. D2729: Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
8. D3034: Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
9. D4716: Standard Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
10. F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
11. F656: Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
12. F1336: Standard Specification for Poly(Vinyl Chloride) (PVC) Gasket Sewer Fittings

D. Caltrans Standard Specifications, 2015
   1. Section 68-Subsurface Drains
   2. Section 96-Geosynthetics

1.4 DEFINITIONS

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

B. ASTM: American Society for Testing and Materials

C. PVC: Polyvinyl Chloride

1.5 SUBMITTALS

A. Follow submittal procedure in accordance with Section 01 10 00, Supplemental General Requirements.

B. Product data for the following:
   1. Perforated pipe and fittings
   2. Solid pipe and fittings
   3. Prefabricated composite drainage panels
   4. Geotextile fabrics
   5. Cleanout plugs or caps
   6. Precast clean out boxes and box covers
   7. Drainage bubblers
   8. Biofiltration soil material

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 - PRODUCTS

2.1 PERFORATED WALL AND SOLID WALL PIPE

A. PVC pipe and Fittings Smaller than 4-inch:
   1. Pipe: ASTM D1785, Schedule 40. Solvent cement joints
   2. Solvent Cement: ASTM D2564. Include primer according to ASTM F656.
   3. Perforation Size, Location, and Spacing: ASTM D2729

B. PVC Pipe and Fittings 4-inch through 15-inch:
   1. Pipe: ASTMD3034, SDR 26. Bell and spigot joints
   2. Perforation Size, Location, and Spacing: ASTM D2729
   3. Fittings: ASTM F1336
   4. Joint Gasket: Elastomeric seal, ASTM F477

2.2 SPECIAL PIPE COUPLINGS

A. Description: ASTM C1173. 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.
   1. Size box to provide access and allow easy removal and reinstallation of plug or cap.
   2. Types:
      a. Non-Traffic Areas: Portland cement concrete box and box cover, light duty.
      b. 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.

C. Cover Markings: “STORM DRAIN” unless otherwise specified.
   1. 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:
      a. Associated Concrete Products, Inc.,
      b. Brooks Products Inc.,
      c. Christy Concrete Products, Inc., or approved equal

2.4 PREFABRICATED COMPOSITE DRAINAGE PANELS

A. Description: Prefabricated composite panels, 36 to 60 inches wide and manufactured with geotextile facing laminated to molded drainage core

B. Drainage Core: Three-dimensional, non-biodegradable, molded Polypropylene or Polystyrene
   1. Minimum Compressive Strength: 10,000-lbf./sq. ft. when tested according to ASTM D1621
   2. Minimum Flow Rate: 2.8 gpm per foot at hydraulic gradient of 0.05 and compressive stress of 25 psig when tested according to ASTM D4716

C. Geotextile: Non-woven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M288
   1. Survivability Class: 1
   2. Apparent Opening Size: No. 70 sieve maximum
   3. Permittivity: 0.5 per second, minimum

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. American Wick Drain Corporation
   2. Tencate Geosynthetics/Mirafi Inc.
   3. Multi-Flow (Prinsburg, MN) (Tel. 800-978-8007)

4. Phillips Fibers Corporation, or approved equal

2.5 BIORETENTION OR BIOFILTRATION TREATMENT SOIL

A. Soil specification shall meet requirements of local agency having authority or sustainability requirements for projects achieving environmental goals.
   1. For projects located within the jurisdiction of the Municipal Regional Stormwater Permit (MRP), treatment soil shall conform to requirements in Appendix L of the MRP. Contractor shall provide submittal information verifying conformance to MRP standard.

2.6 DRAINAGE FILL MATERIAL

A. Permeable Material: Conform to Section 68-2.02F(3) of Caltrans Standard Specifications, Class 2.

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

2.7 GEOSYNTHETICS

A. When required, use filter fabric for encasing permeable material around subdrains.
   1. Caltrans Filter Fabric: Section 96-1.02B of Caltrans Standard Specifications,
   2. Mirafi 140N (by Tencate Geosynthetics/Mirafi Inc.), or approved 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 D2321 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 D2321. 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 31 23 33, Utility Trenching and Backfill and 33 41 00, Storm Utility Drainage Pipe.

3.5 INSTALLATION OF RAIN GARDENS, BIORETENTION OR BIOFILTRATION TREATMENT AREAS

A. The Contractor shall excavate rain gardens / treatment areas to the elevations and dimensions specified on the plans. Level surface of area of top of treatment soil shown on the plans shall govern actual length and width dimensions if shown on the plans. In-situ soils shall not be further compacted.

B. Direct the use of heavy equipment and construction traffic around rain gardens so as to avoid compaction, to the extent possible.

C. After initial site grading, the Contractor shall provide temporary protection from curb cuts and other potential inflow entrances so that runoff drainage does not enter the rain gardens during construction and installation.
1. Treatment areas / rain gardens may be used as sediment settling facilities during mass excavation and commensurate construction activities.
2. Prior to commencing work in rain gardens, the Contractor shall remove and properly dispose of all accumulated sediments.

D. Excavated soils shall be placed with stockpiled fill and properly disposed and stabilized by the Contractor.

E. Subdrain installation:
1. Subdrain shall be installed as indicated on the plans at an elevation within the drain rock layer shown on the construction details and connected to the overflow or outfall structure at the invert elevation shown on the plans.
2. For connections of the perforated drain pipes to storm drainage structures, appropriately sized holes shall be cut in the structures at the correct invert

elevation specified by the Project Designer or authorized representative. The connections shall be sealed sediment-tight and secured in place with mortar or other approved joint sealant compatible with subdrain pipe materials.

3. Drain rock layer shall be approved Class II Permeable Material. Crushed rock or aggregate base cannot be used within the treatment area, in, around or under the drain rock layer.
4. Care shall be exercised to prevent natural or fill soils from intermixing with the drain rock surrounding the underdrain. All contaminated drain rock shall be removed and replaced with uncontaminated Class II permeable material.
5. Attach subdrain piping to overflow structure.
6. Install cleanouts at the ends of the subdrains. Install screw-on end caps set flush with the finished top of treatment soil.

F. Overflow drain structure:

1. Install overflow structure at the elevation and location specified on the plans. Attach subdrain piping to overflow structure. Attach solid pipe from overflow structure outfall storm drain system at elevation and slope indicated on the plans.
2. Rim elevation of overflow structure must be set above the elevation of the top of treatment soil by the amount indicated on the plans, typically 6 inches. Contractor shall verify that the rim elevation of the overflow structure is also a minimum of 2 inches below the lowest elevation of the treatment area perimeter so that storm flows will reach the overflow rim before the top of the treatment area perimeter.
3. The overflow structure shall have an open bottom filled with drain rock if indicated on the plans. This should be installed where the overflow structure has a sump condition (subdrains lower than the outfall invert elevation). The overflow structure shall be installed such that the bottom of the structure is set a minimum of 6-inches below the undisturbed bottom of the treatment area. Drain rock in the overflow sump shall be installed up to the invert of the lowest pipe connected to the structure.

G. Filter media soil backfill

1. Filter soil of the approved specification shall be installed to the elevation indicated on the plans. Care should be taken to ensure that the soil is not compacted and that no equipment is driven on the backfill. Walking on the backfill should be limited to what is absolutely necessary.

H. Planting soil, plantings, and mulch shall be installed per the plans. Non-floating bark / mulch shall be used, if indicated, to prevent removal of material and clogging of the overflow.

I. Testing of the treatment area should be conducted once the filter media is installed and all storm drain piping is connected. The area should allow an infiltration rate well above 5 inches/ hour to ensure that the treatment area will continue to function at 5 inches/ hour over the lifetime of the treatment area.

3.6 PREFABRICATED COMPOSITE DRAINAGE PANELS

A. Coordinate placement with other drainage materials.

B. Install prefabricated drainage panels in accordance with manufacturer’s instructions.

C. Place perforated drainage pipe at base of footing and attach to composite drainage panels in accordance with the manufacturer's instructions.

3.7 JOINING PIPE

A. Join PVC pipe and fittings with elastomeric seals according to ASTM D2321 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.

3.8 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.

3.9 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.

3.10 RETAINING WALL DRAINAGE

A. Unless otherwise specified, drain system should consist of a minimum of 12 inches thick free-draining granular materials containing less than five percent fines passing a No. 200 sieve placed adjacent to the wall. Free-draining granular material should be graded to prevent the intrusion of fines or encapsulated in a suitable filter fabric. As an alternative, a prefabricated drainage structure, such as geo-composite, or approved equivalent, may be used as a substitute for the granular backfill adjacent to the wall.

B. Drainage system consisting of either weep holes or perforated drain lines (minimum 4 inch diameter placed near the base of the wall) should be used to intercept and discharge water which would tend to saturate the backfill. Where used, drain lines should be embedded in a uniformly graded filter material and provided with adequate clean-outs for periodic maintenance.

C. An impervious soil should be used in the upper one foot layer of backfill to reduce the potential for water infiltration.

END OF SECTION

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