DUNPHY PARK SITE IMPROVEMENTS
Technical Specifications

Permit Submittal

August 21, 2017

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SECTION 00 01 01

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END OF SECTION

SECTION 05 70 05
LANDSCAPE METALWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials and equipment as required for complete, finished installation of metalwork as shown on the drawings and specified including the following items:
   1. Steel anchors and bolts
   2. Trash Enclosure Structure
   3. Miscellaneous landscape metal

B. Metal fabrication includes plates, bars, strips, tubes, pipes and castings made from iron and steel that are not specifically listed herein.

1.2 REFERENCES AND STANDARDS

A. "Code for Arc and Gas Welding in Building Construction" of American Welding Society, AWSD1.1, latest edition, with current supplements and addenda, is hereby made a part of this Section and miscellaneous metalwork shall conform to the applicable requirements therein, except as otherwise specified herein or shown on the drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements or governing rules and regulations.

B. All work shall conform to the American Institute of Steel Construction Specifications for design, erection and fabrication, and acceptable standards of good practice. Finished members shall be true to line and free from twists and bends.

C. SSPC "Steel Structures Painting Manual, Volume 2, Systems and Specifications".

D. National Association of Architectural Metal Manufacturers (NAAMM): Metal Finishes Manual

1.3 SUBMITTALS, per Section **01 33 00**

A. Product Data: Furnish manufacturer’s literature including paint, grout and recommendations for cleaning.

B. Shop Drawings: Shall show dimensions, sizes, thicknesses, gauges, finishes, joining attachments and relationship of work to adjoining construction. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings. Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and directions necessary to permit other trades to properly locate their work. Where welded connectors, concrete or masonry inserts are required to receive work, shop drawings shall show exact locations required, and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts. Catalogue work sheets showing illustrated cuts of item to be furnished, scale details and dimensions may be submitted for standard manufactured items.
   1. Provide templates for anchorage installations by others.

C. Samples: Furnish finish samples of uncoated steel anchor and bolts for farm machinery, etc.

D. Certificates: Submit certification signed by California registered civil or structural engineer indicating compliance with Contract Documents and code requirements where required.

1.4 SYSTEM DESCRIPTION

A. Design Requirements: Drawings indicate metal sizes and shapes; unless otherwise specifically indicated, design components and fabrications of gages and thicknesses to withstand anticipated loads as required by California Building Code.
   1. Railings: Support a lateral force of 50 lbs./lin. Ft. uniform load and 200 lbs. at any single point without permanent set or damage; ASTM E 935.
      a. Top Rails: Design to support minimum 200 lb. concentrated single point load applied at any point vertically or horizontally.

B. Rail Regulatory Requirements:
   1. Access: Comply with California Building Code and Americans with Disabilities Act Accessibility Guidelines (ADAAG) Access Requirements and finishes as designated by NAAMM “Metal Finishes Manual” and “Pipe Railing Manual” and referenced standards. Rails shall be welded construction; cap exposed ends.
   2. Building Code: Comply with requirements of applicable building codes for railing design, except where more restrictive codes are specified.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm with minimum five years successful experience fabricating metal items similar to those required for Project.

PART 2 - MATERIALS

2.1 BASIC MATERIALS AND ACCESSORIES

A. Steel Tubing: ASTM A500 (cold-formed), Minimum Grade B, seamless where exposed.

B. Steel Pipe: ASTM A53, Type S, seamless, Grade A, minimum standard weight, STD or Schedule 40, unless otherwise noted.

C. Miscellaneous steel plates and structural steel shapes conforming to ASTM A36-(latest edition).

D. Bolts: Structural grade steel, ASTM A307-(latest edition), with suitable hex nuts and washers, all galvanized except where noted otherwise.

E. Structural Steel Sheet: Hot rolled, ASTM A1011; or cold rolled, ASTM A 1008, Class 1 of grade required for design loading.

F. Castings: Gray iron, ASTM A 48, Class 30; malleable iron, ASTM A47.

G. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron ASTM A47 or cast steel ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.

H. Fasteners and Rough Hardware: Type as required for specific usage; provide zinc-coated fasteners for exterior use or where built into exterior walls.

I. Welding Materials: AWS D1.1, type required for materials being welded.

J. Stainless Steel
   1. Plate, Sheet and Strip: ASTM A167, Type 302 or Type 304. Provide mill finish unless otherwise shown.
   2. Bars and Shapes: ASTM A276, Type 304. Provide mill finish unless otherwise shown.
   3. Tubing: ASTM A269
   4. Stainless Steel Railing Finishes: Submit finish sample for approval. Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated free of cross scratches. Run grain with long dimension of each piece.
   5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

K. Aluminum: Provide alloy and temper recommended by aluminum producer or finisher for type and use and finish indicated; sized for strength and durability consistent with application involved. Comply with the following finishes as designated by NAAMM "Metal Finishes Manual" and referenced standards:
   1. High performance Organic Coating: AA-C12C42R1x, prepared, pretreated and coated with minimum two coat system; AAMA 2605.
   2. Comply with following minimum standards for aluminum.
      a. Extruded Bar and Shapes: ASTM B221, 6063-T6.
      b. Extruded Pipe and Tube: ASTM B429, 6063-T6.
      c. Drawn Seamless Tube: ASTM B483, 6063-T832.
      d. Plate and Sheet: ASTM B209, 6061-T6.
      e. Die and Hand Forgings: ASTM B247, 6061-T6.
      f. Castings: ASTM B26, 356.0-T6.

L. Weathering Steel: (COR-TEN), ASTM A242.

M. Castings: Gray iron, ASTM A 48, Class 30; malleable iron, ASTM A 47.

N. Screws: Galvanized zinc, electro-plated or brass.

O. Welding Electrodes: As permitted by AWS A5.

P. Galvanizing:
   1. Galvanize fabricated items as shown and specified after fabrication in accordance with ASTM A123-09.
   2. Parts shall be made in suitable sections. First clean in a hot pickling bath to remove scale and then rinse clean with clear water. After pickling and washing, dip parts in liquid zinc tank sufficient length of time to heat parts to zinc temperature, then remove and allow to drip and cool; straighten as required.

Q. Non-Metallic Shrinkage Resistant Grout: Premixed, nonmetallic, non-corrosive, non-staining, shrinkage resistant product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621 and ASTM C1107, free of gas-producing or gas-releasing agents, oxidizing catalysts, inorganic accelerators and chlorides. Provide one of the following:
   1. "Five Star Grout" (U.S. Grout Corp.).
   2. "Masterflow 713" (Master Builders Co.).
   3. "Crystex" (L&M Construction Chemicals, Inc.).

R. Fasteners and Anchorage Devices: Provide fasteners complying with the requirements of Industrial Fasteners Institute standards. Type, grade, class and style best suited for the respective purpose. Use countersunk flat-head Phillips type machine screws for exposed fasteners, except where Allen head screws are required. Use galvanized steel or stainless steel fasteners for exterior construction and for fastening components fabricated of galvanized steel except where specified otherwise. Fasteners exposed in finish surfaces to match finish of adjacent surfaces.

S. Component Connections: Fabricate component connections to support specified design loads.

T. Material Selection: Select materials for straightness, free of defects and irregularities.
   1. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, “oil canning”, stains, discolorations, and imperfections on finished units are not acceptable.

U. Joints: Make exposed joints flush butt type, hairline joints where mechanically fastened; provide concealed connection devices with hidden fasteners.
   1. Fabricate continuous items with joints neatly fitted and secured.
   2. Ease exposed edges to approximate 1/32” uniform radius.
   3. Fabricate joints exposed to weather in manner to exclude water or provide weep holes where water could accumulate.

V. Welding: Comply with AWS for recommended practices in welding each type of material; provide welds behind finished surfaces without distortion or discoloration on exposed side; dress exposed and contact surfaces.

W. Exposed Mechanical Fastenings: Flush countersunk fasteners unobtrusively located, consistent with design of structure.

X. Assemblage: fit and shop assemble in largest practical sections for site delivery.

Y. Dissimilar Materials: Separate dissimilar materials with bituminous paint where concealed, with preformed separators, or similar method to prevent corrosion.

2.2 SPECIALLY FABRICATED PRODUCTS

A. Railings and Handrails: Make all bar railings of milled steel unless noted otherwise; all connections welded. Where pipe railing are required, make from (1-1/2) outside diameter seamless steel pipe unless noted otherwise. Fabricate in largest sections feasible; all shop joints welded; all field joints with concealed sleeves and pins.
   1. 1.5” O.D. Stainless Steel Tube HSS1 1/2x0.12
   2. 1.5” I.D (1.9” O.D) Stainless Steel Extra Strong Pipe

B. Railings and Handrails Design: Continuous railings conforming to applicable code and design requirements. Construct to support a concentrated load of 250 lbs. Applied at any point and in any direction and for a uniform load of 50 lbs. Per foot applied in any direction. The concentrated and uniform loading conditions shall not be applied simultaneously.
   1. Wall Rail Brackets: Castings as accepted by Owner's Representative.
   2. Wall returns: 90 degree elbow return with ¼" maximum clearance unless otherwise indicated.
   3. Provide wall plates only where indicated and where required by applicable codes.

C. Steel Bollards: Minimum Schedule 80 seamless steel piping,.

2.3 SHOP PAINTING

A. General:
   1. Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded unless otherwise specified.
   2. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning", prior to any additional surface preparation specified.
   3.
   4. Clean and prepare metal surfaces before applying shop coat. Remove rust and mill scale in accordance with SSPC SP-3 "Power Tool Cleaning".
   5. Immediately after surface preparation, apply primer in accordance with manufacturer's instructions. Use painting methods which will result in full coverage and dry film thickness specified.
   6. Apply one shop coat of primer to fabricated metal items, except apply 2 coats of primer to surfaces inaccessible after assembly or erection. In addition, apply one shop coat of finish paint to entire surfaces of exterior loose lintels, shelf and relieving angles, dunnage and other items as noted or specified. Change color of second or finish coat to distinguish it from the first coat.
   7. Separate dissimilar metals with one coat of dielectric separator. Do not extend coating onto exposed or finished surfaces.
   8. Application: Do not paint when ambient temperature is below 40°F. Paint in dry weather or under cover; paint over dry rust-free surfaces. Stir paint and keep at uniform consistency during application. Apply paint by brush or spray per manufacturer's directions to a dry film thickness of not less than 1.5 mils (approximately 370-375 SF of surface per gallon); do not thin paint in excess of manufacturer's recommendations. Allow paint to dry before handling or shipment.

B. Fully Concealed Items:
   1. Clean steel work by "Solvent Cleaning" method specified in SSPC-SP 1, followed by "Hand Tool Cleaning" to remove loose mill scale and rust by methods specified in SSPC-SP 2.
   2. Apply ferrous metal primer immediately after cleaning to uniform dry film thickness of 2.0 mils.
   3. Apply second coat of same primer and same thickness on concealed work which will be built into below grade work, or will be concealed in areas designated high humidity areas.

C. Exposed Exterior Items:

1. Apply the following cleaning, treatment and painting to exterior work which will be fully exposed or only partially exposed, and to exposed interior work in areas designated as high humidity areas.
2. Clean by "Solvent Cleaning" method specified in SSPC-SP 1, followed by "Power Tool Cleaning" to remove loose mill scale and rust by methods specified in SSPC-SP 3, followed by "Pickling" to remove remaining mill scale and rust by methods specified in SSPC-SP 8. Power tool cleaning and pickling may be omitted from work fabricated from cold-rolled or cold-finished stock, and from castings, provided surfaces are not heavily rusted.
3. Apply pretreatment as recommended by ferrous metal primer manufacturer.
4. Apply prime coat of ferrous metal primer immediately after pretreatment to uniform dry film thickness of 2.0 mils.

D. Exposed Interior Items:
1. Apply the following cleaning treatment and painting to interior work which is exposed (or partially exposed), and is subject to foot traffic, floor cleaning operations or hand contact.
   a. Clean by "Solvent Cleaning" method specified in SSPC-SP 1, followed by "Hand Tool Cleaning" by method specified in SSPC-SP 2, or "Power Tool Cleaning" by method specified in SSPC-SP 3 to remove loose mill scale and rust. "Pickle" by methods specified in SSPC-SP 8 to remove remaining mill scale and rust. Grind rough surfaces smooth. Tool cleaning and pickling may be omitted from work fabricated from cold-rolled or cold-finished stock, and from castings, provided surfaces are not heavily rusted.
   b. Apply pretreatment as recommended by ferrous metal primer manufacturer.
   c. Apply ferrous metal primer immediately after pretreatment to uniform dry film thickness of 2.0 mils.
   d. Paint in dry weather or under cover. Ensure that steel or iron surfaces are free from moisture or frost. Do not deliver fabricated materials until shop coat has dried.

2.4 FINISHES: Except as otherwise noted on the drawings or specified:

A. Preparation of Metal:
1. Ferrous Metal: SSPC-SP-6 (Commercial Blast Clean)
2. Galvanized Metal: SSPC-SP-1 (Solvent Clean)
3. Cut or Welded Galvanized Metal: Surface clean cuts and welds to bright metal
4. Aluminum: SSPC-SP-1 (Solvent Clean)

B. Primer:
1. Ferrous Metal: Tnemic 90-97 (Tneme-Zinc)
2. Galvanized Metal: Tnemic Series P66 Epoxoline
3. Cut or Welded Galvanized Metal: Paint with organic ZMC rich primer with a metallic zinc content of not less than 78% by weight in dry applied film Tnemic-zinc 90E-92 or approved equal. Apply in dry film thickness between 2.0 - 3.5 mils.
4. Aluminum: Tnemic Series 66 Epoxoline

C. Finish Coats:
1. Interior: Tnemic Series (73) or (74) Endura-Shield
2. Exterior: Tnemic Series 74 Endura-Shield
3. Heavy duty Industrial Use: Tnemic Series 74 Endura-Shield

PART 3 - EXECUTION

3.1 CONDITION OF SURFACES: Inspect all surfaces to receive site metal work and report all defects which would interfere with this installation. Starting work implies acceptance of surfaces as satisfactory.

3.2 FIELD MEASUREMENTS: Take field measurements prior to preparation of shop drawings and fabrication, where possible; do not delay job progress; allow for trimming and fitting where necessary.

3.3 WORKMANSHIP

A. Verify all measurements at job. Coordinate all metalwork with adjoining work for details of attachments, fittings, etc. Do all cutting, shearing, drilling, punching, threading, tapping, etc., required for site metalwork or for attachment of adjacent work. Drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces. Obtain Owner's Representative's review prior to site cutting or making adjustments which are not part of scheduled work. Perform necessary cutting and altering for installation and coordination with other work.

B. Conceal all fastenings where feasible. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Form joints exposed to weather to exclude water.

C. Make all permanent connections in ferrous metal surfaces using welds where at all possible; do not use bolts or screws where they can be avoided.

D. Provide all lugs, clips, anchors, miscellaneous fastenings necessary for complete assembly and installation.

E. Set all work plumb, true, rigid, neatly trimmed out, accurately fitted and free from distortions or defects detrimental to appearance or performance. Miter corners and angles of exposed moldings and frames unless otherwise noted.

F. Set railings where shown set in sleeves or cored with quick-setting non-shrink anchor cement. Size sleeves for approximately 1/4" clearance all around.

G. Where items must be incorporated or built into adjacent work, deliver to trade responsible for such work in sufficient time that progress of work is not delayed. Be responsible for proper location of such items.

H. Make provisions for erection stresses by temporary bracing; Keep work in alignment.

I. Install ornamental metal items in accordance with manufacturer's recommendations, installation instructions, and approved shop drawings.

J. Install items plumb, true and in correct relation to adjacent work, free from distortion or defects detrimental to appearance and performance.

K. Prior to securing continuous items, adjust to ensure proper matching at butt joints and correct alignment throughout their length.

L. Tolerances: Accurately align and locate components to required lines and levels to conform to following tolerances:
   1. Plumb: 1/8" in 10'-0"; ¼" in 40'-0"; non-cumulative.
   2. Level: 1/8" in 20'-0"; ¼" in 40'-0"; non-cumulative.
   3. Location: 3/8" maximum deviation from measured theoretical location (any member and location).

3.4 WELDING:

A. Perform all welding in accordance with AWS Code D1.1. Welds shall be made only by operators experienced in performing the type of work indicated. Welds normally exposed to view in the finished work shall be uniformly made and shall be ground smooth. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.

B. Field Welding: Comply with AWS Welding Code for procedures related to field welding as related to appearance and quality of welds made and for methods used in correcting welding work. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.5 BOLTED, SCREWED AND RIVETED CONNECTIONS

A. In general, use bolts for field connections only and then only as detailed. Provide washers under all heads and nuts bearing on wood. Draw all nuts tight and nick threads of permanent connections to prevent loosening. Use beveled washers where bearing is on sloped surfaces.

B. Where screws must be used for permanent connections in ferrous metal, use flat-head-type, countersunk, with screw slots filled and finished smooth and flush.

C. Where rivets are used, they shall be machine-driven, tight, heads centered, countersunk, and finished flush and smooth.

3.6 SURFACE TREATMENT AND PROTECTIVE COATINGS

A. Cleaning: Thoroughly clean all mill scale, rust, dirt, grease and other foreign matter from ferrous metal prior to any galvanizing, hot phosphate treatment or painting. Conditions which are too severe to be removed by hand cleaning methods shall be cleaned per SSPC "Surface Preparation Specifications," "Solvent Cleaning, SSPC-SP-1"; "Power Tool Cleaning, SSPC-SP-3"; or "Brush-Off Blast Cleaning, SSPC-SP 7"; as required.

B. Exterior Ferrous Metal: Welds, burrs, and rough surfaces ground smooth and completed assembly cleaned, hot phosphate treated. Hot phosphate treatment not required on items which are not exposed in the finish work or on those items where size prohibits such treatment. Indicate on shop drawings where treatment is proposed to be omitted.

3.7 PAINTING

A. Prime Coat: After material has been properly cleaned and treated, apply two shop prime coats, each of a different color, to all surfaces except those encased in concrete or masonry. Apply all paint per manufacturer's directions. Spot paint all abrasions and field connections after assembly. Shop coats shall be dry prior to shipment to job site.

B. Finish Coats: Apply one coat per manufacturer's instructions. May be shop-applied where applicable.

3.8 GALVANIZING

A. Galvanize fabricated items after fabrication in accordance with ASTM A123-66.

B. Parts shall be made in suitable sections. First clean in a hot pickling bath to remove all scale and then rinse clean with clear water. After pickling and washing, dip parts in liquid zinc tank sufficient length of time to heat parts to zinc temperature, then remove and allow to drip and cool; straighten as required.

3.9 INSTALLATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and other miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the project site. Deliver items which are to be built into the work of other Sections in time so as not to delay the progress of the Work.

B. Protect finished surfaces against damage during construction and remove protection at time of substantial completion.

C. Railings and Guardrails:
   1. Anchor posts of railings into concrete by means of pipe sleeves preset and anchored into concrete. Set sleeves in concrete with tops flush with finish surface elevations and protect sleeves from water and concrete entry. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with non-shrink non-metallic grout. Cover anchorage joint with a round steel flange welded to post after placement of anchoring material.
   2. Anchor posts to steel members with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
   3. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements. Mount handrails only on gypsum board assemblies reinforced to receive anchors. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Locate posts at spacing indicated, or if not indicated, at equal intervals as required by design loadings.
   4. Secure handrails to wall with wall brackets and end fittings. Provide brackets of design shown, with flanges tapped for concealed anchorage and with not less than 1-1/2 in. clearance from inside face of handrail and finished wall surface. Located brackets as indicated, or if not indicated, at equal spacings as required by design loads.

D. Loose Plates: Prior to setting loose bearing and setting plates, clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates. Set on wedges or other adjustable devices. After members have been positioned and plumbed, tighten anchor bolts. do not remove wedges or shims, but if protruding, cut off flush with the edge of the plate before packing with grout. Pack grout solidly between bearing surfaces and plates to ensure no voids remain.

E. Immediately after erection, clean field welds, bolted connections, marred and abraded surfaces. Paint and touch-up paint with the specified paint system. Touch up galvanized surfaces in accordance with ASTM A780.

F. Replace items damaged in course of construction.

3.10 PROTECTION AND CLEANING, per Section **01 74 00**

A. Remove all soil and foreign matter from finished surface and apply such protective measures as may be required to prevent damage or discoloration of any kind until acceptance of project.

END OF SECTION

SECTION 06 20 10
SITE CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Provide all labor, equipment and materials for the installation of site carpentry, including but not limited to fences, trash enclosure gates, posts, benches, tables, bollards, etc, and as shown on the drawings and specified.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
3. ASTM D1761 Standard Test Methods for Mechanical Fasteners in Wood.
4. ASTM D1037 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.

B. Federal Specifications (FS):
1. FS FF-S-111D Screws, Wood.
2. FF-S-325 Expansion Shields.

C. American National Standards Institute (ANSI):
1. ANSI B18.2.1 Square and Hex Bolts and Screws, Inch Series.

D. International Code Council (ICC):
1. ICC Report ESR 1190, Trex Wood-Polymer Composite Lumber.
2. California Building Code (CBC)

1.3 QUALITY ASSURANCE

A. Douglas Fir: As graded by a certified grading agency approved by the USDA American Lumber Standards Committee.

B. Cedar: As graded by a certified grading agency approved by the USDA American Lumber Standards Committee.

C. Redwood: "Standard Specifications for Grades of California Redwood Lumber" graded under the rules of the Redwood Inspection Service.

D. Lumber: Grade stamp to contain symbol of grading agency, mill number of name, grade of lumber, species of species grouping or combination designation, rules under which grades, where applicable, and condition of seasoning at time of manufacture.
1. Softwood Plywood: Appropriate grade trademark of the American Plywood Association.Type, grade, class and Identification Index.
2. Inspection and testing agency mark.

E. Pressure Treatment of Wood: In accordance with the American Wood Preservers Institute (AWPI) Standards.

F. Glue Laminated Members: Stamp each glued laminated member with an identifying number and furnish certificates of inspection to show grade and species of lumber, slope of grain, type of glue and any other pertinent information for each member.

G. Poles and Posts: Shall conform to American National Standards Institute specifications and dimensions for wood poles 05.1-1972, and poles shall be selected for uniformity and appearance with maximum taper of 1-inch per 10 linear feet.

H. Preservative-treated Lumber: Lumber shall be pressure-treated for "Below Grade Use" in conformance with AWPA Standard C-2.

I. Abbreviations: AD - air dried. KD - kiln dried. VG - vertical grain. FG - flat grain. RWD - redwood. DF - Douglas Fir. PT - pressure-treated. All wood surfaced, four sides, unless otherwise designated "rough".

1.4 PROTECTION

A. Lumber shall be stored in neat stacks at the site unless it is to be used immediately. All lumber shall be piled so that it may be readily inspected and shall be handled in a manner that will avoid injury or breakage.

B. Immediately upon delivery to jobsite, place materials in area protected from weather.

C. Take special care when handling.

D. Store lumber on a flat surface with skids above ground as necessary to prevent warping.

E. When stacking palleted units, start supports at each end and spaced 24" o. c.

F. Line up supports vertically.

1.5 SUBMITTALS

A. Submit listed submittals in accordance with Section 01 33 00.

B. Submit Wood Composite Lumber manufacturer’s product data and installation instructions including details of anchors, hardware and fasteners.

C. Submit selection and verification samples of Wood Composite Lumber decking in color and thickness as specified.

D. Certifications
1. Pressure-treated wood: Submit certification by treating plant stating chemicals and process used, net amounts of slats retained, and conformance with applicable standards.
2. Submit manufacturer’s certificate decking products meet or exceed specified requirements.

PART 2 - MATERIALS

2.1 LUMBER

A. Except where otherwise noted, all lumber shall conform to the allowable characteristics permitted within the applicable grading rule. No splits, checks, holes, decay or other irregularities will be permitted except characteristic of that grade.

B. Lumber shall be as follows:
   1. FSC Certified.
   2. Unless otherwise indicated on drawings or specified, lumber shall be **Select Rough Cut Cedar, Sanded.**
   3. Pressure Treated Lumber for Deck support structure: Douglas fir-Larch, No. 1, pressure-treated as noted below.
   4. Redwood, Construction Heart, S4S and better,
   5. Douglas fir-Larch shall be pressure-treated No. 1 common grade or better, S4S.
   6. Posts shall be pressure-treated, Douglas fir-Larch, or as indicated on the Drawings. Pressure treat Douglas fir with "ACQ". Treat all posts for "below ground use" (.60 lbs. per cubic foot) in conformance with AWPA requirements.
   7. Pressure Treated Lumber shall be incised on all sides unless shown otherwise.
   8. Plywood, CDX, planed finish, 3/4" thickness

2.2 PRESERVATIVE-TREATED LUMBER CONNECTOR SCREWS

A. Self-taping galvanized flat head deck screws

2.3 ACCESSORIES

A. All hardware used to fasten onto Preservative-treated Lumber shall be galvanized steel.

B. Hardware: Provide all necessary nails, screws, clips and bolts required for proper installation of wood and wood composite lumber decking. Sizes and quantities as required by code authority having jurisdiction, unless more stringent requirements specified elsewhere.
   1. Bolts, Exterior Use:
      a. Material Standard: Comply with ASTM A307, with standard washers.
      b. Finish: Galvanized, ASTM A123.
      c. Size: As shown.
   2. Lag Screws:
      a. Material Standard: Comply with ANSI B18.2.1.
      b. Finish: Hot dipped galvanized for exterior use.
   3. Expansion Shields:
      a. Material Standard: Comply with Fed Spec. FF-S-325, Type 1, Group III, Self-drilling.
   4. Nails, General:
      a. Material Standard: Comply with ASTM F1667.
      b. Type: Common unless otherwise indicated.
      c. Finish: Hot dipped galvanized for exterior use.
   5. Square-Head-Drive Self-Taping Screws for attaching wood composite decking.
      a. Trimscrews or equal.

2.4 PRESERVATIVE

A. Preservative-treated Lumber shall be pressure-treated for "Below Grade Use" with ACQ, 0.60 retention, in conformance with AWPA Standard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:
   1. Verify that site conditions are acceptable for installation of materials.
   2. Do not proceed with installation of wood and wood composite lumber until unacceptable conditions are corrected.

3.2 INSTALLATION

A. Workmanship shall be first class throughout. All lumber (except Wood Composite Lumber) shall be accurately cut and framed to a close fit and shall have even bearing over the entire contact surface. All joints shall be square and tight unless otherwise shown. No shimming will be permitted in making joints. Work shall be free of hammer marks, dents or other disfiguration. Nails and other hardware to be sized per U.C.B. Nailing Schedule and to be seated flush unless otherwise shown. Counter-sink finishing nails 1/16 inch. Holes for bolts shall be bored with a bit 1/16 inch larger than the bolt. Holes for lag screws shall be bored with a bit not larger than the base of the thread (75% of the diameter).

B. Lumber Selection: Select individual pieces so that knots and obvious minor defects will not interfere with connections.

C. Install members with crown and tight knots up.

D. Cut joists, rafters and beams as required to provide a full even and horizontal seating on the support, unless otherwise shown, do not overcut.

E. Do not use lumber with end splits greater than the following:
   1. Joists 2x: Split length greater than 1/2 the wide face of the member.
   2. Beams and headers: Split length greater than thickness of member.
   3. Structural blocking: Split length greater than thickness of member.

F. Limit notches and bored holes in joist and beams as follows:
   1. Not permitted unless detailed on the Drawings or approved by the Structural Engineer.
   2. Notches in bottom o in top at cantilever or continuous span not permitted.
   3. Notches in top shall not exceed 1/6th the depth and shall not be located in the middle 1/3 of span.
   4. Bored holes shall not exceed 1-1/2” nor 1/5 of the depth in diameter, and shall not be within 2” of top or bottom.

G. Fastening:
   1. Use such fastenings and connections as required to connect members securely together or to structure.

2. Minimum nailing, not otherwise shown or noted, shall convorm to CBC Table 2304.9.1.
3. Penetration of nails or spikes into piece receiving point shall be not less than ½ length of nail or spike, except, that 16 penny nails may be used to connect pieces of 2” thickness.
4. Drive nails and spikes no closer together than 2/3 their depth nor closer to edge of member than ¼ their depth.
5. Place nails, bolts and other connector without splitting wood.
6. Predrill holes whenever nailing tends to split wood. Replace all split members.
7. All nuts and screws shall be tightened when placed and retightened at completion of the job or immediately prior to closing in.
8. Nuts shall be secured against loosening.

3.3 PRESERVATIVES:

A. Apply specified preservative to all wood in contact with. Moisture content of wood at time of application shall not exceed 25%. When any framing, cutting or boring of treated wood (field cuts) is performed after treatment, swab all cuts, dips and holes thoroughly with heavy application of the same preservative specified for the treatment of the lumber. Install cut end above grade only.

B. Bolts 5/8" and less in diameter shall be fitted with cut washers, and all bolts and lag screws over 5/8" in diameter shall be fitted with cast or malleable iron washers unless otherwise shown on the Drawings. Select bolt length to fit situation. Where bolts project beyond nut, cut off to a point 1/8" from nut and paint same day with heavy coat of Zinc Chromate primer paint and one coat of Aluminum finish paint (to match the galvanized bolt finish, unless otherwise noted).Bolts to be hot dip galvanized.

C. Stainless steel hardware with stainless steel screws and bolts may be used in lieu of hot dip galvanized. Do not mix stainless steel with galvanized steel hardware.

D. Exposed nails in exterior work shall be hot-dipped galvanized except where specified otherwise.

3.4 CLEANING

A. Remove all factory marks and labelss.

B. Sand all damaged surfaces

C. Clean all surfaces

3.5 STAINING & SEALING

A. Stain as noted on drawings.

B. Seal all wood with clear penetrating oil formulated for each wood type, unless otherwise noted on drawings.

3.6 PROTECTION

A. Protect installed work from damage due to subsequent construction or other activity on the site.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in each specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.

B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make his portion of the Electrical Work a finished and working system.

C. Description of Systems shall be as follows:

1. Electrical power system to and including light fixtures, equipment, motors, devices, etc.

2. Grounding system.

3. Wiring system for temperature control system as shown on the drawings.

4. Wiring of equipment furnished by others.

5. Removal work and/or relocation and reuse of existing systems and equipment.

1.3 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.

B. Itemize all work and list associated hours and pay scale for each item.

1.4 ALTERNATES

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system

components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, fire protection systems, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5” and larger, conduit racks, cable trays, pull boxes, transformers, raceway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

a. Scale of drawings:

1) General plans: 1/4 Inch = 1 '-0" (minimum).

2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, rerouting or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Contractor’s Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor’s own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor’s risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.

2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Sausalito, California Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

2. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

4. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

6. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter’s Laboratories, Inc. or a nationally recognized testing organization.

8. Pay all telephone company charges related to the service or change in service.

E. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.

3. Scaling of the drawings will not be sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.

7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better-quality number shall govern.

8. Where used in electrical documents the word “furnish” shall mean supply for use, the word “install” shall mean connect up complete and ready for operation, and the word “provide” shall mean to supply for use and connect up complete and ready for operation.

9. Any item listed as furnished shall also be installed unless otherwise noted.

10. Any item listed as installed shall also be furnished unless otherwise noted.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by Engineering 350.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by Engineering 350 for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by Engineering 350 as to the accuracy or correctness of the information provided. Engineering 350 accepts no responsibility or liability for the Contractor's use of these documents.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.7 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	**Submittal Item**
26 05 19	Low-Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 33	Raceway and Boxes for Electrical Systems
26 05 35	Surface raceways for Electrical Systems
26 05 48	Vibration and Seismic Controls for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 73	Overcurrent Protective Device Coordination Study
26 24 16	Panelboards
26 27 26	Wiring Devices
26 28 16	Enclosed Switches and Circuit Breakers
26 51 00	Lighting

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

    a. Date
    b. Project title and number
    c. Contractor's name and address
    d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
    e. Description of items submitted and relevant specification number
    f. Notations of deviations from the contract documents
    g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

    a. Date
    b. Project title and number
    c. Architect/Engineer
    d. Contractor and subcontractors' names and addresses
    e. Supplier and manufacturer's names and addresses
    f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
    g. Description of item submitted (using project nomenclature) and relevant specification number
    h. Notations of deviations from the contract documents
    i. Other pertinent data
    j. Provide space for Contractor's review stamps

3. Composition:

    a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

    b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

    c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

    a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The

Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

b. Unstamped submittals will be rejected.

c. The Contractor's review shall include, but not be limited to, verification of the following:

1) Only approved manufacturers are used.
2) Addenda items have been incorporated.
3) Catalog numbers and options match those specified.
4) Performance data matches that specified.
5) Electrical characteristics and loads match those specified.
6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
7) Dimensions and service clearances are suitable for the intended location.
8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

D. Paper Copy Submittal Procedures:

1. Paper copies are acceptable where electronic copies are not provided.

2. The Contractor shall submit ten (10) paper copies of each shop drawing.

3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.8 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

   a. Material: Delivered cost of product with taxes paid.
   b. Labor: Labor cost, excluding overhead and profit.

3. Itemize the cost for each of the following:

   a. Overhead and profit.
   b. Bonds.
   c. Insurance.
   d. General Requirements: Itemize all requirements.

4. For each line item having an installed cost of more than $5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:

   a. Each piece of equipment requiring shop drawings. Use the equipment nomenclature (SB-1, PANEL P-1, etc.) on the Schedule of Values.
   b. Each type of small unitary equipment (e.g., FDS, FCS, CS, etc.). Multiple units of the same type can be listed together provided quantities are also listed so unit costs can be determined.
   c. Each conduit system (medium voltage, normal, emergency, low voltage systems, etc.). In addition, for larger projects breakdown the material and labor for each conduit system based on geography (building, floor, and/or wing).
   d. Fire alarm broken down into material and labor for the following:
      1) Engineering
      2) Controllers, devices, sensors, etc.
      3) Conduit
      4) Wiring
      5) Programming
      6) Commissioning
   e. Seismic design
   f. Testing
   g. Commissioning
   h. Record drawings
   i. Punchlist and closeout

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.
2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.9 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

B. Change order work shall not proceed until authorized.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.

B. Keep all materials clean, dry and free from damaging environments.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.11 WARRANTY

A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.12 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.13 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis of design and establishes the quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fit in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on his part or on the part of other Contractors whose work is affected.

E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

2.1 GENERAL

A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions

required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.

2. Covering exterior walls, interior partitions and chases.

3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:

a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.

b. Light fixtures, including ceiling-mounted exit and emergency lights, are installed and operational.

c. Light fixture whips are suspended above the ceiling.

d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.

e. Light fixtures are suspended independently of the ceiling system when required by these contract documents.

f. All wall penetrations have been sealed.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.3 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor's final payment.

4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling tiles.

C. The following must be submitted before Architect/Engineer recommends final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including marked-up or reproducible drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.

4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to Project Manager and submit receipt to Architect/Engineer.

5. Inspection and testing report by the fire alarm system manufacturer.

6. Start-up reports on all equipment requiring a factory installation or start-up.

3.4 OPERATION AND MAINTENANCE (O&M) MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once

corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as “1 of 2”, “2 of 2”, etc.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title “Operation and Maintenance Instructions”, title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, three (3) paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.

2. Binder Requirements: The Contractor shall submit three sets of O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. “Peel and stick” labels are **not** acceptable. Sheet lifters shall be supplied at the front

of each notebook. The three-ring binders shall be 1/2"12mm thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.

3. Binder Labels: Label the front and spine of each binder with “Operation and Maintenance Instructions”, title of project, and subject matter.

4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect’s/Engineer’s shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Copies of all factory inspections and/or equipment startup reports.

5. Copies of warranties.

6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

7. Dimensional drawings of equipment.

8. Detailed parts lists with lists of suppliers.

9. Operating procedures for each system.

10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

11. Repair procedures for major components.

12. Replacement parts and service material requirements for each system and the frequency of service required.

13. Instruction books, cards, and manuals furnished with the equipment.

14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

D. Notify the Architect/Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.

E. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.

F. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner’s representatives for the electrical and specialized systems.

2. If the Contractor does not have staff that can adequately provide the required instructions, he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 RECORD DOCUMENTS

A. The following paragraphs supplement the requirements of Division 1.

B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer’s hourly rates in effect at the time of work.

D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.7 PAINTING

A. This Contractor shall paint the following items:

B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.

C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.

3.8 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.9 SPECIAL REQUIREMENTS

A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.

B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner’s representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner’s representative will result in removal and reinstallation of the equipment at the Contractor’s expense.

D. Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:

1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

3.10 SYSTEM COMMISSIONING

A. The electrical systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls,

balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.

B. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.

1. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.11 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction.

2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.

3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.

4. Any wiring device, electrical apparatus or lighting fixture, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.

5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than the National Electrical Code Standards. Take readings between conductors, and between conductors and ground.

6. If the results obtained in the tests are not satisfactory make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Other Equipment:

1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal

elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.

C. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

D. Contractor shall thermographic study all electrical gear, switchboard, panelboards, etc. at the end of construction to identify any unusual conditions/heating within the equipment. Coordinate with Owner/Architect/Engineer to have an Owner/Architect/Engineer representative present during testing.

E. Report shall include color printouts, in binder, of pictures taken to use as a baseline reading after building is occupied.

F. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Owner for “benchmark” amperages.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 26 05 00, cable insulation test results have been submitted.
5. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
6. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
7. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
8. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
9. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The drawings are intended to indicate the scope of work required and do not indicate every box, conduit, or wire that must be removed. The contractor shall visit the site prior to submitting a bid and verify existing conditions.

B. Where walls, ceilings, structures, etc., are indicated as being removed on general or electrical drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.

C. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.

D. Where mechanical or technology equipment is indicated as being removed on electrical, mechanical, or technology drawings, the Contractor shall be responsible for disconnecting the equipment and removing all starters, VFD, controllers, electrical equipment, raceways, wiring, etc. associated with the device.

E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area. Extended conduit and conductors to match existing size and material.

F. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and electrical service to avoid conflicts.

G. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.

3.2 PREPARATION

A. The Contractor shall obtain approval from the Owner before turning off power to circuits, feeders, panels, etc. Coordinate all outages with Owner.

B. Coordinate utility service outages with Utility Company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.

D. Disconnect electrical systems in walls, floors, structures, and ceilings scheduled for removal.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Provide a watchman to make required premise observations during all outages, requirements as dictated by codes and Owner's insurance carrier.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Division 1 of Specifications and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Electrical demolition shall be performed in accordance with the City of Sausalito Facilities Electrical Demolition Procedure.

D. All breaker and disconnect operation/switching shall be performed by City of Sausalito Qualified Electrical Workers. Contact the Field Construction Manager for assistance with switching and breaker operation.

E. Circuits for which all connected load is to be demolished must be "air-gapped" (disconnected and cut short) at the supply end and, if the load is to be abandoned-in-place, at the load end. Remove conduit entries at supply end panels and plug conduit entry holes. Accessible portions of abandoned conductors and cables should be removed to the extent practical as long as such removal will not place other in-service circuits at risk of damage. Conductors and cables that are air-gapped but cannot be physically removed shall be marked as "disconnected state." Abandoned conduit runs that are not removed shall be capped at both ends and marked as "disconnected state."

F. Remove abandoned wiring and raceway to source of supply. Existing conduit in good condition may be reused in place by including an equipment ground conductor in reused conduit. Reused conduit and boxes shall have supports revised to meet current codes. Relocating conduit shall not be allowed.

G. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

H. Disconnect and remove outlets and devices that are to be demolished. Remove outlet or devices' associated back box, supports, and conduit and conductors back to source. Patch opening created from removal of device to match surrounding finishes.

I. Disconnect and remove abandoned panelboards and distribution equipment.

J. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

K. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Ballasts in light fixtures installed prior to 1980 shall be incinerated in EPA approved incinerator or disposed of in EPA certified containers and deposited in an EPA landfill certified for PCB disposal or recycled by permitted ballast recycler. Punctured or leaking ballasts must be disposed of according to Federal Regulations under the Toxic Substance Control Act. Provide Owner and Architect/Engineer with a Certificate of Destruction to verify proper disposal.

L. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.

M. Maintain access to existing electrical installations that remain active. Modify installation or provide junction boxes and access panel as appropriate.

N. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Extended conduit and conductors to match existing size and material.

O. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in an EPA-permitted hazardous waste disposal facility or by a permitted lamp recycler.

P. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

Q. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means. Where conduit is in concrete slab, cut conduit flush with floor, pull out conductors, and plug conduit ends.

R. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Electrical items (e.g., lighting fixtures, receptacles, switches, conduit, wire, etc.) Removed and not relocated remain the property of the owner. Contractor shall place items retained by the owner in a location coordinated with the owner. The contractor shall be responsible for the disposal of material the owner does not want.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of Division 1 of Specifications.

END OF SECTION

SECTION 26 05 19
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire

B. Remote control and signal cable

C. Fire rated cable

D. Metal-clad cable (MC)

1.2 REFERENCES

A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy

B. UL 44 – Thermoset-Insulated Wires and Cables

C. UL 83 – Thermoplastic-Insulated Wires and Cables

D. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords

1.3 SUBMITTALS

A. Submit shop drawings and product data under the provisions of Section 26 05 00.

B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Feeders and Branch Circuits Larger than 6 AWG: Copper, stranded conductor, 600 volt insulation, THHN/THWN or XHHW-2.

B. Feeders and Branch Circuits Larger than 6 AWG in Underground Conduit: Copper, stranded conductor, 600 volt insulation, THWN or XHHW-2.

C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN. Solid conductor, unless otherwise noted on the drawings.

D. Motor Feeder from Variable Frequency Drives: Copper conductor, 600 volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings. Three conductor stranded coverall helical copper tape shield. Shield shall be terminated at both ends of cable with an approved termination.

E. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THWN.

F. Each 120 branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

2.2 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60ºC, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

A. Above Accessible Ceilings: Building wire including Low voltage cable (less than 100 volts) shall be installed in raceways. Low voltage cables in ducts, plenums and other air-handling spaces shall be plenum listed. Metal clad cable, Type MC, 1/2” size with minimum #12 conductors and ground, shall be allowed for flexible whips, no longer than 6’-0”, to individual luminaires on non-essential circuits.

B. Above Grade: All conductors installed above grade shall be type “THHN”.

C. Underground or In Slab: All conductors shall be type “THWN”.

3.2 WIRE FOR SPECIALIZED SYSTEMS

A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed:

1. Fire alarm
2. Low voltage switching
3. Electronic control
4. Security
5. Data

3.3 CONTRACTOR CHANGES

A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.16.

B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.

C. Underground electrical duct ampacity rating shall be in accordance with NEC Table B.310.15(B)(2)(7) or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.

D. Record drawing shall include the calculations and sketches.

3.4 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.

B. Use no wire smaller than 18 AWG for low voltage control wiring (<100 volts).

C. Use 10 AWG conductor for 20 amperes, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.

D. Use no wire smaller than 8 AWG for outdoor lighting circuits.

E. The ampacity of multiple conductors in one conduit shall be derated per National Electrical Code, Article 310. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.

F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.

G. Splice only in junction or outlet boxes.

H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

I. Make conductor lengths for parallel circuits equal.

J. All conductors shall be continuous in conduit from last outlet to their termination.

K. Terminate all spare conductors on terminal blocks, and label the spare conductors.

L. Cables or wires shall not be laid out on the ground before pulling.

M. Cables or wires shall not be dragged over earth or paving.

N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.

O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.

P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.5 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires. Do not use wire pulling lubricant for isolated (ungrounded) power system wiring.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially thru raceway.

D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.

E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.

F. Only nylon rope shall be permitted to pull cables into conduit and ducts.

G. Completely and thoroughly swab raceway system before installing conductors.

3.6 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage.

B. Use suitable cable fittings and connectors.

C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4”=1’-0” or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer’s written instructions, applicable codes, the NECA’s “Standard of Installation”, recognized industry standards; and coordinated with other contractors.

D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables. J-hooks shall be Caddy CAT or Mono Systems H-433 series.

E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.

F. J-hook supports shall be installed at a maximum of five-foot (5') intervals. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal separation and 6" vertical separation between systems.

G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.7 WIRING CONNECTIONS AND TERMINATIONS

A. Splice and tap only in accessible junction boxes.

B. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

C. Thoroughly clean wires before installing lugs and connectors.

D. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

E. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.

F. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:

1. Facing the front and operating side of the equipment, the phase identification shall be:

a. Left to Right - A-B-C
b. Top to Bottom - A-B-C

G. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

3.8 MC CABLE INSTALLATION

A. Cable shall be supported by an approved means every 4.5' and within 12" of outlet boxes, junction boxes, cabinets, or fittings.

B. Cable may be unsupported in the following conditions:

1. Cable is no longer than 2' in length at terminals where flexibility is necessary.
2. Cable is not more than 4.5' from the last point of support for connections within an accessible ceiling to light fixtures or equipment.

C. Conductor ampacity shall be derated as required by the NEC where more than three current carrying conductors are used.

D. Each 120 and 277 volt circuit shall have a dedicated neutral conductor. Neutral

conductors shall be considered current-carrying conductors for cable derating.

E. Cables shall be cut using a rotary cutter as recommended by the manufacturer to eliminate nicking and cutting of the conductors.

F. Bending radius shall comply with the requirements listed in the NEC for the type and size of cable being installed, but shall not be less than 5-times the diameter of the cable in any case.

G. At cable terminations, a fitting shall be provided to protect wires from abrasion, unless the design of the outlet boxes or fittings is such as to afford equivalent protection, and, in addition, an insulating bushing or its equivalent protection shall be provided between the conductors and the armor.

3.9 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 1.

B. Building Wire and Power Cable Testing: Test shall be made by means of an insulation testing device such as a “Megger” using not less than 500 volts D.C. test potential.

C. Inspect wire and cable for physical damage and proper connection.

D. Torque test conductor connections and terminations to manufacturer's recommended values.

E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

F. Provide documentation of the manufacturer’s recommended lug torque value, the date the lugs were torqued, and installed torque readings. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to tightening of lugs shall be provided.

G. Protection of wire and cable from foreign materials:

1. It is the Contractor’s responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer’s performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.

H. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor’s responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment grounding system
B. Bonding system

1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.

B. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with UL 467 Grounding and Bonding Equipment.

E. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 26 05 00.

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

C. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Indicate layout of ground field, location of system grounding electrode connections, and routing of grounding electrode conductor and ground ring.

1.4 SUMMARY

A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables".

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Sizes and types below are typical. Adjust to suit Project conditions and requirements.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus:

1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4” x 2” length of electrical room.

J. Intersystem Bonding Termination:

1. Copper bar, 1/4” x 2” x 2”. Provide with wall mounting brackets, insulators and pre-tapped holes.

2. Approved Manufacturers: Harger GBI Series, Erico B544 Series.

2.2 CONNECTOR PRODUCTS

A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors: Hydraulic compression type and Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

C. Bolted Connectors: Bolted-pressure-type connectors.

PART 3 - EXECUTION

3.1 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

F. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to provide physical protection.

G. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. In raceways, use insulated equipment grounding conductors.

E. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

3.3 EQUIPMENT GROUNDING SYSTEM

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Lighting and receptacle circuits. Terminate each end on a grounding lug or bus.
2. Single-phase and three-phase motor and appliance branch circuits.
3. Flexible raceway runs, including FMC and LFMC.
4. Metal-clad cable runs.

3.4 BONDING SYSTEM

A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side of the expansion joint.

B. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.

C. Cable trays: Bond to the grounding electrode system with #4/0 AWG bare copper conductor. Run #4/0 AWG bare conductor continuously along the length of the cable tray system. Secure with grounding clamps Burndy GC2929CT or approved equal.

D. Equipment Circuits: Install a bonding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, dampers, and heaters. Bond conductor to each unit and to air duct. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps or copper conductor sized equal to the equipment grounding conductor.

E. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

F. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.

G. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.

H. Terminal Cabinets: Terminate bonding conductor on cabinet grounding terminal.

I. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.

3.5 CONCRETE OR WOOD BUILDING GROUNDING SYSTEM

A. Provide a copper common grounding electrode conductor for the attachment of multiple separately derived systems in accordance with NEC 250.30(A)(4)(a) through 250.30(A)(4)(c). Individual grounding conductor taps from the separately derived systems to the common grounding electrode shall be sized in accordance with NEC 250.66. All tap connections shall be made in an accessible location in such a manner that common grounding electrode conductor remains without a splice or joint.

3.6 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.

2. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:

3. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

4. Testing: Perform the following field quality-control testing:

   a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

3.7 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rigid metallic conduit and fittings
B. Electrical metallic tubing and fittings
C. Flexible metallic conduit and fittings
D. Liquidtight flexible metallic conduit and fittings
E. Rigid polyvinyl chloride conduit and fittings
F. Wall and ceiling outlet boxes
G. Electrical connection
H. Pull and junction boxes
I. Rough-ins
J. Handholes
K. Accessories

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
4. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
5. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

B. NECA “Standards of Installation”

C. National Electrical Manufacturers Association (NEMA):

1. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
2. RN 1 – Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
3. TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
4. TC 9 – Fittings for PVC Plastic Utilities Duct for Underground Installation

D. National Fire Protection Association (NFPA):

1. ANSI/NFPA 70 – National Electrical Code

E. Underwriters Laboratories (UL): Applicable Listings

1. UL 1 – Flexible Metal Conduit
2. UL 6 – Rigid Metal Conduit
3. UL 360 – Liquid Tight Flexible Steel Conduit
4. UL514-B – Conduit Tubing and Cable Fittings

5. UL651-A – Type EB and a PVC Conduit and HDPE Conduit
6. UL746A – Standard for Polymeric Materials – Short Term Property Evaluations
7. UL797 – Electrical Metal Tubing
8. UL1242 – Intermediate Metal Conduit

F. American Standard of Testing and Materials (ASTM):

1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics
2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edge Wise Position
4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material

G. Definitions:

1. Fittings: Conduit connection or coupling.

2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.

3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.

4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.

5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.

7. Slab: Horizontal pour of concrete used for the purpose of a floor or sub-floor.

1.3 SUBMITTALS

A. Include fittings and conduits 1.5” and larger in coordination files. Include all in-floor and underfloor conduit in coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

B. Provide product submittals to the Architect/Engineer, per specifications, on floor boxes and slip sleeves for approval prior to purchase and installation.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Acceptable Manufacturers:

1. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.

2. Acceptable Manufacturers of RMC Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, Crouse-Hinds, Killark, or approved equal.

B. Minimum Size Galvanized Steel: 3/4 inch (19mm), unless otherwise noted.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.

2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.

3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**

5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

D. PVC Externally Coated Conduit: Compliant with UL 6, ANSI C80.1 and NEMA RN 1; rigid galvanized steel conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit bodies shall be complete with coating. Threads shall be hot galvanized and coated with a clear coat of urethane. The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a complete encapsulated system. Acceptable Manufacturers: Robroy, T&B Ocal or approved equal.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers of EMT Conduit: Allied, LTV, Steelduct, Wheatland Tube Co, or approved equal.

C. Fittings and Conduit Bodies:

1. 2" Diameter or Smaller: Compression type of steel designed for their specific application.

2. Larger than 2": Compression type of steel designed for their specific application.

3. Acceptable Manufacturers of EMT Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, or approved equal.

2.3 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.

B. Acceptable Manufacturers: American Flex, Alflex, Electri-Flex Co, or approved equal.

C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.

D. Fittings and Conduit Bodies:

1. Screw-in type, die-cast zinc.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: O-Z/Gedney Co., Thomas & Betts, Appleton Electric, Electroline, Bridgeport, Midwest, Regal, or approved equal.

2.4 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

A. Acceptable Manufacturers: Anaconda Type UA, Electri-Flex Type LA, Alflex, Carlon (Lamson & Sessions), or approved equal.

B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.

C. Fittings and Conduit Bodies:

1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: Appleton Electric, O-Z/Gedney Co., Electroline, Bridgeport, Thomas & Betts, Midwest, Regal, Carlon (Lamson & Sessions), or approved equal.

2.5 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers: Carlon (Lamson & Sessions) Type 40, Cantex, J.M. Mfg., or approved equal.

C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.

D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.

E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.6 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, minimum of 14 gauge, with 1/2 inch male fixture studs where required.

B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

C. Cast Boxes: NEMA FB1, Type FD, Aluminum or cast feralloy, deep type, gasketed cover, threaded hubs.

D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.

E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.

F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.

G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.7 ELECTRICAL CONNECTION

A. Electrical connection to equipment and motors, sized per NEC. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.8 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.

C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.

E. Flanged type boxes shall be used where installed flush in wall.

2.9 ROUGH-IN

A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,

B. Conduit stubbed to above the lay-in ceiling or routed to the corridor cable tray.

2.10 ACCESSORIES

A. Fire Rated Moldable Pads: UL #9700, moldable sheet putty at required thickness on all five sides of back boxes. Kinetics Noise Control – IsoBacker Pad, SpecSeal – SSP Putty and Pads, 3M #MPP-4S or equal.

PART 3 - EXECUTION

3.1 CONDUIT SIZING

A. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to N.E.C. (Latest Edition). Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the National Electrical Code (to include enlarged conductors due to temperature and quantity derating

values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.

B. Minimum Conduit Size (Unless Noted Otherwise):

1. Above Grade: 3/4 inch.

2. Below Grade 5' or less from Building Foundation: 1 inch.

3. Below Grade More than 5' from Building Foundation: 1 inch.

4. Telecommunication Conduit: 1 inch.

5. Controls Conduit: 3/4 inch.

C. Maximum Conduit Size Embedded in Slabs above Grade: 1 1/4 inch for conduits crossing each other.

D. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.2 CONDUIT ARRANGEMENT

A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.

B. Conduit shall not share the same cell as structural reinforcement in masonry walls.

C. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.

D. Contractor shall adapt his work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.

E. Contractor shall cooperate with all Contractors on the project. He shall obtain details of other Contractor's work in order to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by him. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

3.3 CONDUIT SUPPORT

A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.

B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.

C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.

D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.

F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.

G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the National Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.

J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.

K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the National Electrical Code requirements.

L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.

M. Finish:

1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.

2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1” of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6’-6” of finish floor and presents potential injury to personnel.

3.4 CONDUIT INSTALLATION

A. Conduit Connections:

1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.

2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.

3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.

4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.

B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.

C. Conduit Bends:

1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.

2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).

3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.

4. Telecommunications conduits shall have no more than two (2) 90 degree bends between pull points and contain no continuous sections longer than

100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.

a. A third bend is acceptable if:

1) The total run is not longer than (33) feet.
2) The conduit size is increased to the next trade size.

5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter into the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.

6. Telecommunications conduit bend radius shall be six (6) times the diameter for conduits under 2” and ten (10) times the diameter for conduits over 2”.

7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.

8. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the National Electrical Code.

2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.

3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.

4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5” below bottom of roof decking.

5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.

6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM

E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal.

7. Contractor shall be responsible for all openings required in masonry or exterior walls under this division. A qualified mason at the expense of this contractor shall repair all openings to match existing conditions.

8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, equal to O-Z/Gedney type EYD.

9. Horizontal conduit routing through slabs above grade

    a. Conduits, if run in concrete structure, shall be in middle one-third of slab thickness, and leave at least 3” min. concrete cover. Conduits shall run parallel to each other and spaced at least 8” apart centerline to centerline. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Maximum conduit outside diameter 1”.

    b. No conduits are allowed in concrete on metal deck unless expressly approved in writing by the Structural Engineer.

    c. No conduits are allowed to be routed horizontally through slabs above grade.

10. Do not route conduits across each other in slabs on grade.

11. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.

12. Where rigid polyvinyl chloride conduit (PVC) is used below grade, in a slab, below a slab, etc., a transition to rigid galvanized steel or PVC-coated steel conduit shall be installed before conduit exits earth. The metallic conduit shall extend a minimum of 6" into the surface concealing the non-metallic conduit.

13. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.

14. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.

15. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3” above finished floor (AFF).

16. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4” below ceiling and as close to the wall as possible.

17. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4” above finished floor (AFF) and as close to the wall as possible.

3.5 CONDUIT TERMINATIONS

A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, or approved equal.

B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.

C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.

D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.

E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the National Electrical Code, shall be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6’ in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.

F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer’s recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.

G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of any and all foreign matter prior to any wires or pull cords being installed.

3.6 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) OVERHEAD CONDUIT INSTALLATION

A. Conduit shall be installed away from high temperature piping and equipment.

B. Conduit shall be installed to prevent exposure to ultraviolet radiation.

C. Proper allowances shall be made for expansion and/or contraction of the conduit during installation.

D. Expansion fittings shall be installed in any 100' continuous run of conduit and at each 100' thereafter.

E. Supports shall be made from non-corroding materials and spacing shall not be greater than the listing in the National Electrical Code, but also shall not exceed the manufacturer's recommendations depending on the expected surface temperature.

3.7 UNDERGROUND CONDUIT INSTALLATION

A. Conduit Connections:

1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.

B. Conduit Bends (Lateral):

1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.

2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2” and ten times the diameter for conduits over 2”. Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to determine bend radius.

C. Conduit Elbows (vertical):

1. Minimum metal or RTRC elbow radiuses shall be 18 inches for secondary conduits (<600V). Increase radius, as required, based on pulling tension calculation requirements.

D. Conduit Placement:

1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.

2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.

3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum f'c = 2500 and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.

4. Before the Contractor pulls any cables into the conduit he shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.

5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.

6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.

7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.

8. All non-metallic conduit installed underground outside of a slab shall be rigid.

E. Horizontal Directional Drilling:

1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.

F. Raceway Seal:

1. Where a raceway enters a building or structure, it shall be sealed with a sealing bushing or duct seal to prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceway shall also be sealed.

2. All telecommunications conduits and innerducts, including those containing cables, shall be plugged at the building and vault with “JackMoon” or equivalent duct seal, capable of withstanding a 10 foot head of water (5 PSI).

3.8 CONDUIT INSTALLATION SCHEDULE

A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If This Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the National Electrical Code shall be required.

B. The following schedule shall be adhered to unless they constitute a violation of applicable codes or are noted otherwise on the drawings.

1. Exposed:

    a. Switchboards, panel feeders, etc.: RMC.

    b. Branch Circuits (lighting, receptacles, controls, etc.): EMT.

    c. Mechanical Equipment Feeders (pumps, AHU's, etc.): RMC.

    d. Floor Mounted Pump Feeders: RMC with no more than 6’ of PVC coated flexible metal conduit to pump.

    e. Controls: EMT painted blue or dyed blue.

2. Finished Spaces/Concealed: EMT.

3. Wet or Damp Locations: RMC conduit, boxes and fittings, installed and equipped so as to prevent water from entering the conduit system.

4. Corrosive Locations: PVC Coated Rigid Metal conduit, boxes and fittings installed and equipped so as to prevent water from entering the conduit system.

5. In Slabs Above Grade: Embedded PVC.

6. Site Conduits:

    a. Within 5' from the Perimeter of a Building Foundation: RMC conduit with a minimum of 3" thickness between the surface of the concrete and the nearest conduit. Concrete to be doweled into the foundation.

    b. 5' or Greater from the Perimeter of a Building Foundation: PVC.

7. Hazardous Locations as Defined by the National Electrical Code: RMC conduit complete with screwed fittings and conduit seals.

3.9 BOX INSTALLATION SCHEDULE

A. Galvanized steel boxes may be used in:

1. Concealed interior locations above ceilings and in hollow studded partitions.
2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8’ above the highest platform level.
3. Direct contact with concrete except slab on grade.

B. Cast boxes shall be used in:

1. Exterior locations.
2. Exposed interior locations within 8’ of the highest platform level.
3. Direct contact with earth.
4. Direct contact with concrete in slab on grade.

5. Wet locations.

3.10 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.

D. Locate and install to maintain headroom and to present a neat appearance.

E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

3.11 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls.

1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.

2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.

B. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

C. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)

D. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.

E. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

F. Provide knockout closures for unused openings.

G. Support boxes independently of conduit.

H. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

I. Install boxes in walls without damaging wall insulation.

J. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.

K. Position outlets to locate luminaires as shown on reflected ceiling drawings.

L. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

M. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

N. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

O. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.

3.12 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

C. Do not install boxes back-to-back in walls.

1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer’s instructions.

2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.

D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

3.13 EXPOSED BOX INSTALLATION

A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.

B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.

C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.

D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.

E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)

F. Wood, plastic, or fiber plugs shall not be used for fastenings.

G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION

SECTION 26 05 35
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Multi-outlet assemblies
B. Surface metal raceways
C. Surface non-metallic raceways
D. Auxiliary gutters (metal wireways)
E. Auxiliary gutters (non-metallic wireways)

1.2 REFERENCES

A. FS W-C-582 - Conduit, Raceway, Metal, and Fitting; Surface

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 26 05 00.

B. Include product data for surface metal raceways, multi-outlet assemblies, surface non-metallic raceways, auxiliary gutters, and accessories.

PART 2 - PRODUCTS

2.1 SURFACE METAL RACEWAY

A. Surface Metal Raceway: FS W-C-582; sheet metal channel with fitted cover, suitable for use as a continuous surface metal raceway.

B. Finish: Rust inhibiting primer coat for field painting. Coordinate paint color with Architect.

C. Fittings: Couplings, elbows, and connectors designed for use with raceway system.

D. Boxes and Extension Rings: Designed for use with raceway systems.

E. Coverplates shall be same material and finish as raceway.

F. Normal power receptacles shall be same color as raceway.

G. Receptacles and outlets shown on raceway on drawings shall be mounted with overlapping faceplates in the raceway and shall not be mounted in boxes unless specifically noted otherwise.

H. Surface metal raceway, metallic cover, minimum 2” opening, minimum 3 square inch capacity.

1. Approved Manufacturers: Wiremold G3000, Mono-Systems SMS3200, Hubbell HBL3000 Series.

I. Surface metal raceway, metallic cover, minimum 4” opening, power / communication divider, minimum 7.5 square inch capacity.

1. Approved Manufacturers: Wiremold G4000/G4048, Mono-Systems SMS4200, Hubbell HBL4750 Series.

J. Surface metal raceway, metallic cover, minimum 4” opening, power / communication divider, minimum 16.6 square inch capacity.

1. Approved Manufacturers: Wiremold G6000/G4048, Mono-Systems SMS4400, Hubbell HBL6750 Series.

2.2 SURFACE NON-METALLIC RACEWAY

A. Surface Non-Metallic Raceway: Polyvinyl chloride channel with fitted cover; UL listed for power conductors.

B. Length: As shown on the drawings.

C. Finish: Field paint with latex paint; color selected by Architect.

D. Fittings and Accessories: Couplings, elbows, outlet and device boxes, and connectors designed for use with the raceway system.

E. Coverplates shall be same material and finish as raceway.

F. Normal power receptacles shall be same color as raceway. Coordinate color with Architect.

G. Acceptable Manufacturers: Wiremold PN20A Series, Hubbell PW2 Series.

PART 3 - EXECUTION

3.1 INSTALLATION - SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY

A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.

B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

C. Maintain grounding continuity between raceway components to provide a continuous grounding path.

D. Fastener: Use clips and straps suitable for the purpose.

E. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer’s raceway accessories as needed.

3.2 INSTALLATION - SURFACE NON-METALLIC RACEWAY

A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.

B. Do not locate raceway near heating elements, open flames or surfaces with a probable temperature greater than 150°F.

C. Do not locate raceway where there is a probability of contact with oils, chemicals or moisture.

D. Contractor shall install a bonded ground conductor the entire length of the raceway.

E. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer's raceway accessories as needed.

F. Provide conduits to technology raceway per drawings or provide a minimum of one (1) 1-1/4" conduit per six feet of assembly (minimum 2) to above ceiling for technology requirements if assembly has technology raceway (Contractor shall provide quantities of conduits that provide maximum capacity to assembly). Provide conduits equally spaced within entire length of assembly.

G. Provide one (1) 3/4" empty conduit per six feet of assembly (minimum 1) to above ceiling for future power needs. Provide conduits equally spaced within entire length of assembly.

END OF SECTION

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SECTION 26 05 48
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Seismic Requirements

1.2 QUALITY ASSURANCE

A. General:

1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.

2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for the purpose of seismic restraint.

3. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.

B. Manufacturer:

1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.

2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.

C. Installer: Company specializing in performing the work of this Section.

1.3 REFERENCES

A. ASHRAE - A Practical Guide to Seismic Restraint
B. California Building Code 2016

1.4 SUBMITTALS

A. Submit under provisions of Section 26 05 00.

B. Shop Drawings:

1. Calculations, restraint selections, and installation details shall be designed and sealed by a Licensed Structural Engineer in the State of California experienced in seismic restraint design and installation, and licensed in the state where the project is located.

2. Coordination Drawings: Plans and sections drawn to scale and coordinating electrical components with other systems and equipment in the vicinity for use in the development and layout of seismic bracing design.

3. Manufacturer's Certifications: Licensed Structural Engineer in the State of California shall review and approve manufacturer's certifications of compliance.

4. System Supports/Restraints: Submit for each condition requiring seismic bracing:

   a. Sealed engineering calculations for each seismic brace and housekeeping pad details utilized on the project.

   b. Sealed plan drawings showing locations of seismic braces on contractor fabrication/installation drawings.

   c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.

   d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.

5. Equipment: Submit for each piece of equipment supplied:

   a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified. Equipment certification is to be provided by the manufacturer.

   b. Specific details of seismic design features of equipment.

   c. Sealed engineering calculations and details for equipment anchorage and support structure.

C. Field Installation Observation:

1. An observation report shall be submitted by the seismic designer for general conformance of the seismic restraint systems upon the completion of observations required by this section.

2. The observation report shall be signed by the seismic designer, who is a Licensed Structural Engineer in the State of California experienced in

seismic restraint design and installation, and licensed in the state where the project is located.

D. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and state, in writing, the system has been installed in accordance to the exception.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.6 PROJECT CONDITIONS

A. This project is subject to the seismic bracing requirements of the California Building Code, 2016 edition.

B. Equipment shall meet California Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

1.7 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

1.8 WARRANTY

A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SEISMIC DESIGN CRITERIA

A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.

B. Definitions

1. Stay in Place:

a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.

2. Remain Operational:

a. Requirements for “Stay in Place” listed above shall be met.

b. The following systems and associated equipment is intended not to fail externally or internally and is intended to remain operational.

1) Life Safety Power
2) Emergency Power System
3) Fire Alarm

2.2 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General**:**

1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record.

2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer’s submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.

3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.

4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.

5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized below.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2. The seismic restraint designer shall design housekeeping pads.

2.3 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.

B. Sealed engineering drawings indicating the specified seismic design criteria are met shall be provided in the equipment submittals.

C. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:

1. Distribution Panelboards, Panelboards, Load Centers
2. Emergency Feeders
3. Cable tray
4. Transformers
5. Disconnect Switches
6. Magnetic, Manual, Combination Starters
7. Variable Frequency Drives
8. Automatic/Manual Transfer Switches
9. Interior Luminaires
10. Emergency Luminaires and Exit Signs
11. Emergency Power Supply
12. Uninterruptible Power Supplies
13. Fire Alarm Panel, Initiating and Notification Appliances
14. Area of Rescue Assistance
15. Security System

2.4 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.

2. Outdoors and Damp Locations: Galvanized steel.

3. Corrosive Locations: Stainless steel.

2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with CBC, ACI and ICC ES requirements for cracked concrete anchors.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.6 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch (41-by-41-mm) cross section, formed from 0.1046-inch- (2.7-mm-) thick steel, with 9/16-by-7/8-inch (14-by-22-mm) slots at a maximum of 2 inches (50 mm) o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 570, GR 33.

2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.

3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.

4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.

B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.

C. All rigid floor mounted equipment must have a resilient media between the equipment mounting hole and the anchor bolt in concrete.

D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.

E. Installation of seismic restraints shall not cause any change in position of equipment lighting or conduits resulting in stresses or misalignment.

F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.

G. Do not install any equipment or conduit that makes rigid connections with the building unless isolation is not specified.

H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect's/Engineer's attention prior to specific equipment selection.

I. Prior to installation, bring to the Architect's/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.

J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.

K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.

L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.

M. Do not install cables over sharp corners.

N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.

O. Provide reinforced clevis bolts when required.

P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.

Q. Post-Installed anchors shall be provided to meet seismic requirements.

R. Vertical conduit risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.

S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.

T. Conduit crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the conduit, equipment connections, or support connections. Conduit offsets, loops, anchors, and

guides shall be installed as required to provide required motion capability and limit motion of adjacent conduit.

U. Do not brace a system to two different structures such as a wall and a ceiling.

V. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

W. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.

X. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.

3.2 SEISMIC RESTRAINT EXCLUSIONS

A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

3.3 FIELD OBSERVATIONS

A. General conformance of seismic restraints of system components and equipment shall be field observed by the seismic designer and reported as properly installed.

B. The Contractor shall correct all deficiencies noted by the seismic designer.

C. A final observation and observation report by the seismic designer shall occur.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates and tape labels

B. Wire and cable markers

C. Conduit labeling

D. Conduit color coding

E. Conductor color coding

F. Electrical gear labeling

G. Power distribution equipment labeling

H. Transformer equipment labeling

I. Series rating identification

J. Pole identification

1.2 REFERENCES

A. ANSI C2 – National Electrical Safety Code

B. NFPA 70 – National Electrical Code

C. ANSI A13.1 – Standard for Pipe Identification

D. ANSI Z535.4 – Standard for Product Safety Signs and Labels

1.3 SUBMITTALS

A. General: Submit the following in accordance with Division 1 Specification Sections and under provisions of Section 26 05 00.

1. Product Data for each type of product specified.

2. Schedule of nomenclature to be used for identification signs and labels for each piece of equipment including, but not limited to, the following equipment types as specified in Division 26.

3. Samples of each color, lettering style and other graphic representation required for identification materials including samples of labels and signs.

4. Identification required in this section shall apply to equipment furnished in Division 26 and any other applicable Divisions including Division 21/22/23.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

A. Adhesive Marking Labels for Raceway: Pre-printed, flexible, self-adhesive vinyl labels with legend indicating voltage and service (Emergency, Lighting, Power, HVAC, Communications, Control, Fire).

1. Label Size as follows:

a. Raceways: Kroy or Brother labels 1-inch high by 12-inches long. (Minimum)

2. Color: As specified for various systems.

B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

C. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

E. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.

F. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.

G. Aluminum, Wraparound Marker Bands: 1" in width, .014 inch thick aluminum bands with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

H. Brass or aluminum Tags: 2" by 2" by .05-inch metal tags with stamped legend, punched for fastener.

I. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label, minimum of 3/4” high x 9/16” wide, with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.

2.2 NAMEPLATES AND SIGNS

A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners. Engraving legend shall be as follows:

1. Black letters on white face for normal power.

2. White letters on red face for emergency power.

3. White letters on green face for grounding.

4. Black letter on yellow face for Caution or UPS.

B. Baked–Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting ¼" grommets in corners.

C. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with .0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting ¼" grommets in corners.

D. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

E. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.

B. Install identification devices in accordance with manufacturer's written instruction and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.

D. Identify Junction, Pull and Connection Boxes: permanent magic marker (color coded), neatly hand printed.

E. Circuit Identification: Tag or label conductors as follows:

1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.

2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.

3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

F. Apply warning, caution and instruction signs as follows:

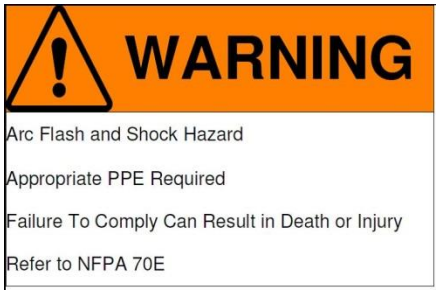
1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

2. Emergency Operating Signs: Install, where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.

H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

I. Install ARC FLASH WARNING signs on all switchboards, panelboards, industrial control panels, and motor control centers. Sign at a minimum shall contain:



J. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

3.2 SWITCH AND RECEPTACLE COVER PLATES

A. Provide identification on all switch and receptacle cover plates. Identification shall indicate source and circuit number serving the device (i.e. “C1A #24”).

B. Identification material to be a clear, 3/8-inch Kroy tape or Brother self-laminating vinyl label with black letters in normal size “Swiss 721 Bold” font. Letter and number size to 3/16-inch high. Embossed Dymo-Tape labels are not acceptable.

Permanently affix identification label to cover plates, centered above the receptacle openings.

3.3 CONDUIT AND EXPOSED CABLE LABELING

A. Conduit Identification: Pre-printed, flexible, self-adhesive vinyl labels with legend at 20 foot intervals to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible. Labels for multiple conduits shall be aligned. Use the following colors

1. 600 Volts and Below Normal: White letters on black background indicating feeder identification and voltage.

2. 600 Volt and Below Emergency: White or black letters on red background indicating feeder identification and voltage.

3. Fire Alarm: Red letter on white background indicating “FIRE ALARM”.

4. Temperature Control: White or black letters on blue background.

5. Grounding: White letters on green background indicating “GROUND” and equipment and designation.

6. Security System: Blue letters on yellow background indicating "Security".

7. Telephone System: Green letters on yellow background indicating "Telephone".

B. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

3.4 BOX LABELING

A. All junction, pull, and connection boxes shall be identified as follows:

1. For power and lighting circuits, indicate system voltage and identity of contained circuits (“120V, 1LA1-3,5,7”).

2. For other wiring, indicate system type and description of wiring (“FIRE ALARM NAC #1”).

B. Box covers shall be painted to correspond with system type as follows:

1. Fire Alarm: Red
2. Critical: Orange
3. Optional Emergency Branch: Yellow
4. Temperature Control/Building Automation: Blue
5. Box color to match conduit color indicated below.

3.5 CONDUIT COLOR CODING SCHEDULE

A. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:

1. Fire Alarm System: Red.
2. Normal Power Distribution System: Silver.
3. Emergency Power Distribution System: Orange.
4. Temperature Controls, Motor Control and Other Control Systems: Blue
5. Low Voltage and Telephone: Purple.
6. Ground: Green.

B. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

C. This Contractor shall furnish and install framed 8" x 10" charts of the color coded identification scheme used for the electrical system in all electrical rooms and next to the main fire alarm panel.

3.6 CONDUCTOR COLOR CODING

A. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.

B. Where more than one nominal voltage system exists in a building or facility, the identification of color coding used in the panelboard or equipment shall be permanently posted on the interior of the door or cover.

C. All wires and cables, 6 AWG or larger, used in motor circuits, main feeders, sub-main feeders and branch circuits, shall be coded by the application of plastic tape. The tape shall be 3-M, Plymouth or Permacel, in colors specified below. The tape shall be applied at each conductor termination with two 1-inch tape bands at 6-inch centers. Contractor option to use colored cabling in lieu of the tape at each end for conductor 6 AWG to 500 KCM.

D. Wire and cables smaller than 10 AWG shall be color coded by the manufacturer.

E. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.

F. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.

G. Conductors shall be color coded as follows:

1. 208Y/120 Volt, 4-Wire:

a. A-Phase – Black

b. B-Phase – Red
c. C-Phase – Blue
d. Neutral – White
e. Ground Bond – Green

2. 120/208 Volt, 3-Wire, Isolated (Ungrounded) Power System:

a. A-Phase – Orange with distinctive colored stripe other than white, green or gray along the entire length of the conductor
b. B-Phase – Brown with distinctive colored stripe other than white, green or gray along the entire length of the conductor
c. C-Phase – Yellow with distinctive colored stripe other than white, green or gray along the entire length of the conductor
d. Ground Reference – Green

3.7 ELECTRICAL GEAR LABELING

A. Exterior electrical gear shall be identified with vinyl label names and numbers to be visible on the exterior of the gear. The labels shall correspond to the 1-line nomenclature and identify each cubicle of multi-section gear.

3.8 CONTROL EQUIPMENT IDENTIFICATION

A. Provide identification on the front of all control equipment, such as disconnect switches, lighting control panels, etc. Nameplate text shall be a minimum of 1/4" high.

B. Labeling shall include:

1. Equipment type and contract documents designation of equipment being served.
2. Location of equipment being served if it is not located within sight.
3. Voltage and phase of circuit(s).
4. Panel and circuit number(s) serving the equipment.
5. Method of automatic control, if included ("AUTO CONTROL BY FCMS").

EXHAUST FAN EF-1 ("LOCATED ON ROOF")
480V, 3-PHASE
FED FROM "1HA1-1"

3.9 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

A. Provide identification on the front of all power distribution equipment, such as panelboards, switchboards, etc. The identification material shall be engraved plastic-laminated labels. Text shall be a minimum of 1/4" high, Swiss 721 Bold.

B. Labeling shall include:

1. Equipment type and contract documents designation of equipment.
2. Voltage of the equipment.
3. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.

4. Rating and type of the overcurrent protection device serving the equipment if it is not located within sight ("FED BY 400A/3P BREAKER").

DISTRIBUTION PANEL DP-H1 480Y/277V FED FROM SWITCHBOARD “SB-1” (LOCATED IN MAIN ELECTRIC ROOM)

C. A separate nameplate for the service entrance equipment shall be labeled with the MAXIMUM AVAILABLE FAULT CURRENT and DATE of calculation given on the one-line diagram.

D. Distribution panelboards and switchboards shall have each overcurrent protection device identified with name and location of the load being served ("AHU-1 LOCATED IN PENTHOUSE 1").

E. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part of the O&M Manuals. Refer to Section 26 05 00 for other requirements.

3.10 SERIES RATING IDENTIFICATION

A. Upstream devices of series rated components not enclosed in a single NEMA type enclosure shall be identified with a nameplate using 1/8-inch lettering height reading "CAUTION - SERIES RATED SYSTEM - IDENTICAL COMPONENT REPLACEMENT REQUIRED".

B. Downstream devices of series rated components not enclosed in a single NEMA type enclosure shall be identified with a nameplate using 1/8-inch lettering height reading "CAUTION - SERIES RATED SYSTEM - ADDITIONAL SERIES COMBINATION RATING: XX,XXX RMS SYMMETRICAL AMPERES" where XX,XXX shall be the series combination rating.

3.11 POLE IDENTIFICATION

A. Lighting poles, bollards and overhead distribution poles shall be individually identified with a unique number, for maintenance purposes. Apply the vinyl label number above the hand hole cover or 24” above grade. Bollards may be identified with a number applied inside the luminaire that is visible from the exterior.

END OF SECTION

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Work included: Services necessary to complete the system analysis studies required for the item specified under this Division, including but not limited to:

1. Short circuit study.

2. Protective device evaluation study.

3. Protective device coordination study.

4. Arc flash evaluation study.

B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with equipment specified elsewhere to perform a complete analysis study.

1.2 REFERENCES

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

1. American National Standards Institute, Inc. (ANSI):

a. ANSI Z535.4; Product Safety Signs and Labels.

2. Institute of Electrical and Electronic Engineers (IEEE):

a. IEEE 1584; Guide for Performing Arc-Flash Hazard Calculations.

3. National Fire Protection Association (NFPA):

a. NFPA 70E; Electrical Safety Requirements for Employee Workplaces.

1.3 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 05 00: Common Work Results for Electrical, the following items:

1. The results of the Short Circuit Analysis and Coordination Study shall be summarized in a final report. Three (3) bound copies of the final report shall be submitted.

2. The report shall include the following Sections:

a. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system, which is included within the scope of the study.

b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding it.

c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding it.

d. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

e. Recommended size for power fuses and recommended settings for ground fault relays and for all adjustable trip relays.

f. Tabulations of arc flash evaluation study results and commentary regarding results.

g. Sample arc flash warning label.

B. The study shall be submitted to Owner's Representative prior to final review of the distribution equipment shop drawings and prior to release of equipment for manufacture. If formal completion of the study may cause delay in equipment manufacture, approval from the Owner's Representative may be obtained for a preliminary submittal of sufficient data to ensure that the selection of device ratings and characteristics will be satisfactory. Then the formal study will be provided to verify the preliminary findings.

1.4 QUALITY ASSURANCE

A. The system analysis studies shall be performed by the switchboard/switchgear manufacturer or by an independent testing company.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL

A. The studies shall include all portions of the electrical distribution system from the main normal power service down to and including the 120/208 VAC distribution system. Normal system connections and those that result in maximum fault conditions shall be adequately covered in the study.

3.2 SHORT CIRCUIT STUDY AND PROTECTIVE DEVICE EVALUATION STUDY

A. The short circuit study shall be performed with the aid of a computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.

B. The study input data shall include the maximum available short circuit contribution, resistance and reactance components of the branch impedance, the X/R ratios, base quantities selected, and another source impedance.

C. Short circuit close and latch duty values and interrupting duty values shall be calculated based on maximum available current at each switchboard, low voltage motor controls, distribution panelboards, pertinent branch circuit panelboards and other significant locations through the system. The short circuit tabulations shall include asymmetrical fault currents, symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

D. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the Architect's attention.

3.3 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, ground fault relays and low voltage breaker trip characteristics and settings. The studies shall be in accordance with the latest applicable IEEE and ANSI standards.

B. The coordination study shall include all medium and low voltage classes of equipment from the building or central plant service protective devices down to and including the largest rated device in the low voltage motor controls and panelboards. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices, including the ground fault system devices.

C. The time-current characteristics of the specified protective devices shall be drawn on log-log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

D. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment and recommended settings. A tabulation of the recommended power fuse selection shall be provided for the medium voltage fuses where applied in the system. Any discrepancies, problem areas, or inadequacies shall be promptly brought to the Owner’s Representative attention.

3.4 ARC FLASH EVALUATION STUDY

A. An arc flash evaluation study shall be performed to identify the shock hazard and appropriate personnel protective equipment (PPE) required at each switchboard, distribution board, panelboard, etc. in accordance with the referenced standards.

B. The arc flash evaluation study shall include all voltage classes of equipment from the service entrance down to and including the panelboards.

C. The company performing the arc flash evaluation study shall provide arc flash and shock hazard warning labels for all equipment evaluated. Labeling shall be as follows:

1. Label type:

   a. 4” x 6” for Hazard Class 1 or less.

   b. 5” x 7” for Hazard Class greater than 1.

   c. White vinyl or polyester with orange warning symbol and black text.

   d. Industrial grade self-adhesive backing.

   e. Printed information shall be from the evaluation study results.

   f. Labeling shall be by Created with Brady “PowerMark” Sign, Label Maker or approved equal.

2. Hazard Class 1 label information:

   a. Equipment name.

   b. Available short circuit current.

   c. Flash protection boundary.

   d. Incident energy at 18 inches expressed in cal/cm^2.

   e. PPE required.

3. Hazard Class greater than 1 label information:

   a. Equipment name.

   b. Available short circuit current.

   c. Flash protection boundary.

d. Incident energy at 18 inches expressed in cal/cm^2.

e. PPE required.

f. Voltage shock hazard.

g. Limited shock approach boundary.

h. Restricted shock approach boundary.

i. Prohibited shock approach boundary.

D. Labels shall be affixed to all equipment covered under the evaluation study.

3.5 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT

A. The equipment manufacturer shall provide the services of a qualified field engineer and necessary tools and equipment to test and calibrate the protective relays, ground fault relays and circuit breaker trip devices as recommended in the Short Circuit Analysis and Coordination Study.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Distribution panelboards**: [DP-#], [DP-#]**
B. Lighting and appliance branch circuit panelboards**: [Panel 'A']**

1.2 RELATED SECTIONS AND WORK

A. Refer to the One-Line Diagram and Panel Schedules for size, rating, and configuration.

1.3 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers

B. NEMA PB 1 - Panelboards

C. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

D. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment

E. UL 248 – Low-Voltage Fuses

F. UL 67 - Panelboards

1.4 SUBMITTALS

A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Selective coordination study to prove that all essential electrical systems, emergency systems and legally required standby system panelboards are selectively coordinated with all supply side overcurrent protective devices.

1.5 SPARE PARTS

A. Keys: Furnish four (4) each to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.

2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D QMB, I-Line
b. General Electric Spectra ADS
c. Siemens F2, P4
d. Cutler Hammer PRL4, PRL5

B. Panelboards: NEMA PB 1; type as shown on the drawings.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with concealed trim clamps and hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.

G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240 volt panelboards; 50,000 amperes rms symmetrical for 480 volt panelboards, or as shown on the drawings.

H. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

I. Molded Case Circuit Breakers with Current Limiters: Provide circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

J. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

K. Solid State Molded Case Circuit Breakers: **(All breakers identified on plans as solid-state with 1,200 ampere frame sizes and below.)** Provide molded case switch with electronic sensing, timing, and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with a sealable clear cover.

L. Suitable for use as service entrance equipment.

2.3 BRANCH CIRCUIT PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D NQ, NF
b. General Electric AQ, AE
c. Siemens P1
d. Cutler Hammer PRL1, PRL2

B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.

G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.

J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.

B. Height: 6 feet to handle of highest device.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Label each circuit with the type of load and the name and number of the area served. Revise directory to reflect circuit changes required to balance phase loads.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Device plates and box covers
B. Receptacles including GFCI tamper resistant
C. Wall switches
D. Indoor occupancy and vacancy sensors
E. Cord and plug sets
F. Poke-through fittings
G. Cord reel

1.2 QUALITY ASSURANCE

A. Provide similar devices from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency to Authorities Having Jurisdiction and marked for intended use.

C. Comply with NFPA 70.

1.3 REFERENCES

A. DSCC W-C-896F – General Specification for Electrical Power Connector

B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet

C. FS W-S-896 - Switch, Toggle

D. NEMA WD 1 – General Color Requirements for Wiring Devices

E. NEMA WD 6 – Wiring Devices – Dimensional Requirements

F. UL 498 – Standard for Attachment Plugs and Receptacles

G. UL 943 – Standard for Ground Fault Circuit Interrupters

H. UL 1472 – Solid-State Dimming Controls

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

C. Submit manufacturer occupancy sensor coverage patterns applicable to this project. For areas requiring multiple sensor devices for appropriate coverage,

submit specific manufacturer approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.

1.5 COORDINATION

A. Receptacles for Owner Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

A. All switch, receptacle, outlet, and coverplate colors shall be ivory, unless indicated otherwise.

2.2 COVERPLATES

A. All switches, receptacles, and outlets shall be complete with the following:

1. Thermoplastic/thermoset plastic coverplates in finished spaces where walls are finished.

2. #302 stainless steel coverplates in unfinished spaces for flush boxes.

3. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate securing screws shall be metal with head color matching the wall plate finish.

2.3 RECEPTACLES

A. Refer to Electrical Symbols List for device type.

B. NEMA 5-20R Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap.

2. Approved Manufacturers: Hubbell 5352A, Leviton, 5362-S, Pass & Seymour 5362, Cooper 5352.

C. NEMA 5-20R Ground Fault Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GF20L, Leviton GFNT2, Pass & Seymour 2097, Cooper SGF20.

D. NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:

1. 125 volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face. Provide NEMA 3R rated while-in-use cast aluminum cover.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GFTR20/(RW57300) WP826, Leviton GFWT2/(5977-CL) M5979, Pass & Seymour 2097TRWR/(WIUC10-C) WIUCAST1, Cooper WRSGF20/(WIU-1) WIUMV-1.

E. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.

F. Side wired devices shall have four binding screws that are undercut for positive wire retention.

G. Ground Fault Circuit Interrupter (GFCI) receptacles shall comply with the 2006 edition of U.L. 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

H. Isolated ground receptacles shall have the equipment ground contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from the mounting strap.

I. Integral surge suppression receptacles with integral surge suppression shall comply with the following:

1. Category A3 listed.

2. Line to ground, line to neutral, and neutral to ground modes.

3. Metal-oxide varistors with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 210 joules per mode.

4. Status indication: Light visible in the face of the device and audible alarm to indicate device is no longer active or in service.

5. Distinctive symbol on device face to denote SPD-type device.

6. Device shall be blue with stainless coverplate.

7. NEMA 5-20R duplex receptacle, 125 volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap.

a. Approved Manufacturers: Hubbell HBL5362SA, Leviton, Pass & Seymour, Cooper.

J. Receptacles with modular wiring type quick connectors shall comply with the following in addition to the above:

1. Wired with #12 THHN Cu, stranded or solid, 3 or 4 wire as required for device, minimum 6" lead length.

2. Connector contacts shall be crimped or welded.

3. Modular connector shall be flush with back of device when fully inserted.

2.4 WALL SWITCHES

A. Refer to Electrical Symbols List for device type.

B. Single Pole Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell HBL1221, Leviton 1221-2, Pass & Seymour PS20AC1, Cooper AH1221.

C. Spring Wound Local Timer Switch:

1. 125 volt, 20 amp rated. 0 to 60 minute off delay.

2. Approved Manufacturers: Paragon SWPD60M, Tork A560M, Mark-Time 9008.

D. Local Timer Switch:

1. User adjustable timeout, 120/277 volt, 800/1200 watt rating. No minimum load requirement. Flashes lights one minute before timeout.

2. Approved Manufacturers: Watt Stopper TS-400, Hubbell Automation TD200.

E. Emergency Single Pole Switch:

1. Single throw, 120/277 volt, 20 amp maintained contact. Red toggle handle, side and back wired. Switch shall have with illuminated handle that is illuminated when load is off.

2. Approved Manufacturers: HBL1221R, Leviton 1221-2R, Pass & Seymour PS20AC1-RED, Cooper AH1221RD.

F. Three-way Switch:

1. 120/277 volt, 20 amp. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell 1223, Leviton 1223-2, Pass & Seymour PS20AC3, Cooper AH1223.

2.5 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied, with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time delay for turning lights off when unoccupied.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13 amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.

c. Time Delay and Sensitivity Adjustments: Recessed and concealed.

5. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.

7. Power Supply and Slave Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2” knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.

8. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.

9. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.

10. Warranty: Five (5) year warranty.

B. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. 360 Degree Coverage Pattern:

    a. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Integrated ambient light level sensor (2 to 200 FC range), adjustable sensitivity and time delay. Sensor shall control all circuits in area, unless noted otherwise. Initial settings: ambient sensor 40 FC.

    b. Approved Manufacturers: Watt Stopper DT 300 Series, Hubbell OMNI-DT2000 or ATD2000C, Greengate OAC-DT, Leviton OSC##-MOW, Sensor Switch CM PDT 10.

2. Wall Mounted on Adjustable Swivel Mount:

    a. Wall or ceiling sensor with adjustable settings to allow manual on/auto off or auto on/auto off. Integrated ambient light level sensor (2 to 100 FC range).

    b. Approved Manufacturers: Watt Stopper DT-200 Series, Hubbell LODTRP, Leviton OSM12--M series.

3. Wall Switch:

    a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12’ x 15’ pattern.

    b. Approved Manufacturers: Watt Stopper DW-100 Series, Hubbell LHMTS, Leviton OSSMT series.

4. Wall Switch:

    a. Multi-relay wall switch with manual on/auto off for two separate loads. 120/277 VAC load relay rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12’ x 15’ pattern.

    b. Approved Manufacturers: Watt Stopper DW-200 Series, Hubbell LHMTD, Leviton OSSMD series.

5. Sensitivity Adjustment: Separate for each sensing technology.

6. Detection Coverage:

    a. Task Areas: Detect occupancy anywhere in an area based on hand motion.

    b. Circulation Areas: Detect occupancy anywhere in an area based upon half-step walking motion.

C. Mask sensors where necessary to prevent nuisance switching from adjacent areas.

D. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.

1. High Bay - Aisle Coverage Pattern:

a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay. Sensor shall control all luminaires in area. Initial settings: Time delay 10 minutes.

b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.

2. High Bay - 360 Degree Coverage Pattern:

a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay. Sensor shall control all luminaires in area.

b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.

3. Wall Switch Occupancy Sensor:

a. Passive infrared, zero crossing circuitry, adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.

b. Approved Manufacturers: Watt Stopper PW-100 Series, Sensor Switch WSX, Hubbell LHIRS1 or AP1277, Leviton ODS15, Greengate OSW-P-0451.

4. Dual Wall Switch Occupancy Sensor:

a. Passive infrared, zero crossing circuitry. Switches control two separate circuits or relays. Adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.

b. Approved Manufacturers: Watt Stopper PW-200 Series, Sensor Switch WSD-2, Hubbell LHIRD2 or AP127712, Leviton ODS, Greengate OSW-P-0451.

2.6 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection, FS/UL listed.

2.7 POKE-THROUGH FITTINGS

A. UL listed as fire-rated poke-through device for 1, 1-1/2 and 2 hour rated floors: include fire stops and smoke barriers in through-floor component.

B. Terminate in 4-inch square by 2-1/2 inch deep junction box.

C. Suitable for installation with a floor thickness of 2-1/4 to 7 inches.

D. Semi-flush die-cast aluminum carpet flange.

E. Spring loaded receptacle covers.

F. Verify color with Architect.

G. Fire Rated Poke-Through:

1. Flush mounted. For use with 3-inch core holes. 125 volt, 20 amp, NEMA 5-20R duplex receptacle with 3/4" conduit and junction box. Provide with two (2) data jacks. With painted aluminum flange.

2. Approved Manufacturers: Hubbell PT2X2, Wiremold, Thomas & Betts.

H. Fire Rated Poke-Through:

1. Flush mounted. For use with 4-inch core holes. Provide with one (1) 125 volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for six data jacks and oversized conduit, with painted aluminum flange.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell S1PT4X4, Wiremold, Thomas & Betts.

I. Fire-Rated Multi-Service Recessed Poke-Through:

1. Recessed mounted. For use with 6-inch core holes. Provide with two 125 volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for eight data jacks and 2" conduit.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell S1R6 series, Wiremold 6AT series.

J. Fire-Rated Multi-Service Recessed 8" Poke-Through:

1. Recessed mounted. For use with 8-inch core holes. Provide with two (2) 125 volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for 12 data jacks and 2" conduit.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell S1R8 series, Wiremold 8AT series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install light switches, dimmers, and convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.

B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.

C. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This may include X-ray or similar non-destructive means.

D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.

E. All receptacles installed in walls shall be GFCI type.

F. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.

G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

H. Install devices and wall plates flush and level.

I. Contractor to verify that wall dimmer ratings are achieved where a ganged installation is used.

J. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Identification for Electrical Systems.

K. Identify locations of power packs, control units, and relays above ceiling on record drawing.

L. Test receptacles and modular wiring connectors for proper polarity, ground continuity and compliance with requirements.

END OF SECTION

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SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fusible switches
B. Non-fusible switches
C. Molded case circuit switches
D. Molded case switches
E. Motor disconnect switch
F. Mechanically interlocked disconnect
G. Enclosures

1.2 RELATED SECTIONS AND WORK

A. Refer to the Wiring and Panelboard Schedules for rating and configuration.

1.3 REFERENCES

A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Product Data: For each type of enclosed switch, circuit breaker, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.

C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.

B. Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: Type as indicated on plans.

D. Accessories: As indicated on plans.

2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES

A. Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip settings.

3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time adjustments.
d. Ground-fault pickup level, time delay, and I^2t responses.

4. Current Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

B. Molded Case Switches: Molded case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Accessories: As indicated on plans.

2.3 MOTOR DISCONNECT SWITCH

A. Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

B. Enclosures: Type as indicated on the plans.

C. Ground lug connection provided in enclosure.

D. Accessories: As indicated on the Disconnect Schedule.

E. Listed UL 508 suitable for motor control.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on the drawings.

B. Install fuses in fusible disconnect switches.

C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.2 ADJUSTING

A. Set field-adjustable circuit breaker trip ranges.

END OF SECTION

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SECTION 26 50 00
LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires and accessories
B. Exterior luminaires and accessories
C. Lamps
D. Ballasts
E. Poles

1.2 REFERENCES

A. ANSI C78.377-2008 – Specifications for the Chromaticity of Solid State Lighting Products

B. ANSI C82.11 - High Frequency Fluorescent Lamp Ballasts

C. ANSI C82.77-2002 – Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment

D. IEEE C2 - National Electrical Safety Code

E. UL 935 – Standard for Fluorescent Lamp Ballasts

F. Project site classification as defined in IESNA RP-33 LZ2.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Submit product data sheets for luminaires, lamps, ballasts, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with fixtures listed in ascending order, and with each luminaire's associated lamp, ballast, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.

C. Submit lens product data, dimensions and weights if not included in product data sheet submittal.

D. Include outline drawings, support points, weights, and accessory information for each luminaire type.

E. Submit utility rebate forms, where offered at project location, with rebate items completed.

F. LED luminaire submittals shall include photometric report per IESNA LM-79-08 for the latest generation system being furnished, including independent testing laboratory name, report number, date, luminaire model number, input wattage,

luminaire, and light source specifications. Manufacturer origin of LED chipset and driver shall be submitted.

G. For all LED luminaires specified as dimmer controlled, submit dimmer device data that is approved by manufacturer of submitted luminaire and that Contractor proposes to furnish and install. Contractor is responsible for verifying that installed dimming controls are compatible with and approved by the luminaire manufacturer.

H. Environmental Requirements:

1. Light Pollution Reduction:

a. Exterior Luminaires: Submit manufacturer data showing percentage of light lumens emitted at or above 90° from nadir for each luminaire type.

2. Toxic Material Reduction:

a. Submit manufacturer published data for each lamp type being furnished, indicating mercury content in milligrams per lamp.

1.4 EXTRA STOCK

A. Provide extra stock under provisions of Section 26 05 00.

B. LED Light Engines or Modules: Ten (10) percent of quantity installed, minimum of one (1) of each size and type.

C. Lenses: Five (5) percent of quantity installed, minimum of one (1) of each size and type.

D. LED Drivers: Five (5) percent of quantity installed, minimum of one (1) of each size and type.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site. Store and protect under provisions of Section 26 05 00.

B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.

C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.6 WARRANTY

A. Light emitting diode (LED) light engines and drivers shall have a five-year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.

B. Parabolic Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction. Provide ballast covers to separate inboard/outboard lamps when multi-level switching is indicated, so light does not spill into unlit cells.

C. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified.

D. Exit Signs: Stencil face, 6 inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings.

E. Painted reflector surfaces shall have a minimum reflectance of 90%.

F. All painted components shall be painted after fabrication.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Listed for wet or damp location as scheduled. Fountain and pool luminaires shall be listed for submersible location to meet depth specified.

B. Provide low temperature ballasts or LED drivers, with reliable starting to -20°F.

C. In-grade luminaires shall have lamp/optic separation to prevent surface temperature from exceeding 115°F. Compartment separation of wire entry and control gear/lamp chamber.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Light emitting diodes used in interior applications shall have a minimum color rendering index (CRI) of 80. Light emitting diodes used in exterior applications shall have a minimum color rendering index (CRI) of 80. Color temperature of the luminaires shall be as noted on the luminaire schedule.

B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.

C. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.

D. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have overheat, short-circuit and overload protection, power factor 0.90 or above and maximum

total harmonic distortion of 20%. Surge suppression device for all exterior luminaires.

2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type.

3. Driver shall have a minimum of 50,000 hours rated life.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. If ceiling framing is not listed for luminaire size or weight, support luminaires independent of ceiling grid with a minimum of two (2) #12 gauge wires located on diagonal corners.

B. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Support luminaires independent of ceiling with a minimum of two (2) #12 gauge wires located on diagonal corners.

C. Support surface-mounted luminaires directly from building structure. Install luminaires larger than eight square feet (8 ft^2) or weighing more than 30 pounds independent of ceiling framing.

D. Support suspended or pendant mounted luminaires independent of ceiling grid with a minimum of two #12 gauge wires. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.

E. Provide seismic bracing of luminaires per CBC Chapter 16. Design pendant luminaires on a component seismic coefficient (Cc) of 0.67. Design vertical supports with a factor of safety of 4.0. Contractor shall verify the Seismic Hazard Exposure Group and Performance Criteria Factor.

F. Fire-rated Ceilings: Support luminaires independent of ceiling system with a minimum of two (2) #12 gauge wires.

G. Install lamps in lamp holders of luminaires.

H. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.

I. Parabolic louvers and other optical accessories shall remain in protective wraps or films until construction in area is complete and area has been cleaned.

J. Industrial Pendant Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between ballast and structure. Provide safety chain between reflector and ballast.

K. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.

L. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.2 RELAMPING

A. Replace failed lamps at completion of work. Replacement of lamp burnouts after the warranty period starts shall be the responsibility of the final user.

3.3 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Touch up luminaire and pole finish at completion of work.

3.4 LUMINAIRE SCHEDULE

A. As shown on the drawings.

END OF SECTION

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SECTION 31 10 00
SITE PREPARATION & PLANT PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes requirements for clearing and grubbing, demolition, removal, salvage, relocation reconstruction, or other disposal and/or reconstruction of existing facilities which interfere with the construction, including removal of items below ground.

B. Preserve and protect all improvements to remain, including existing trees, shrubs, utilities, pavements, structures and improvements on adjoining properties during removal work, site preparation work and construction.

C. Provide tree and shrub pruning and removal in accordance with these Specifications if required by the Contract Documents.

D. Layout and review of utility and irrigation trenches that occur in the Tree Protection Root Zone.

E. Related requirements specified elsewhere include:
1. Section 31 20 00, EARTH MOVING
2. Section 32 84 00, IRRIGATION
3. Section 32 90 00 , PLANTING

1.2 QUALITY ASSURANCE

A. Reference Standards:
1. 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 than is required by the above mentioned codes and regulations, the provisions of these Specifications and Drawings shall take precedence. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.

2. International Society of Arboriculture, Guide for Plant Appraisal, latest version.

B. Pre-installation Conference:
1. Conduct conference at the project site. Contractor shall review and identify with the Owner’s Representative the limits of Work and extent of plant materials and other improvements to be protected. Notify Owner's Representative of discrepancies between existing conditions and Drawings before proceeding with Work.
2. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
   a. Tree-service firm's personnel, and equipment needed

b. Arborist's responsibilities.
c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.
e. Trenching by hand or with air spade within protection zones.

C. At the Owner’s discretion, an Arborist may represent the Owner to review the work of the Contractor in regards to plant protection. Arborist Qualifications: ISA Certified Arborist licensed to work in the State of California.

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

1.3 PROJECT CONDITIONS

A. Coordination: Coordinate this work with the work of other Sections to avoid delay and interference with other work.

B. Nuisances: Keep dirt, dust, noise and other objectionable nuisance to a minimum. Use temporary enclosures, coverings and sprinkling, and combinations thereof, as necessary to limit dust to lowest practicable level, except do not use water to the extent that it causes flooding or contaminated run-off.

C. Traffic: Conduct work to ensure minimum interference with vehicular and pedestrian traffic, and to permit unencumbered access to site and adjacent properties.
1. Do not close or obstruct streets, sidewalks, alleys or other public passageways without permission from authorities having jurisdiction.
2. If required by governing authorities, provide alternate routes around closed and obstructed traffic ways.

D. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust toward protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

1.4 DEFINITIONS

A. Diameter breast height (DBH): diameter of a trunk as measuredat a height 54 inches above the ground line.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and as identified on the drawings or otherwise by a certified arborist.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

E. Structural Root Zone: A circular area with the tree trunk at the center and a radius equal to 3 times the diameter of the tree trunk measured at breast height (4.5 feet above ground line). This zone, where most of the structural roots exist, is based upon tree failure research conducted by E.T. Smiley at the Bartlett Tree Research Laboratory. Any structural (buttress) root, which has been severed or is rotten within this zone, can no longer provide adequate support to the tree and must be considered missing.

F. Dripline: The area of the ground directly beneath the vertical projection (shadow) of the trees foliage canopy.

1.5 SUBMITTALS

A. Product Data: For each type of product.

B. Soil Analysis Report:
   1. Provide soil analysis report for any top soil to be removed and stockpiled for reuse as planting soil. Soils analysis report to be performed by Wallace Laboratories LLC (310-615-0116), a certified soil analysis laboratory, and include agricultural suitablity analysis and recommendations for amending the soil. Subsoil will not be approved as planting soil.

C. Samples: For each type of the following:
   1. Organic Mulch: 1-quart of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
   2. Planting Soil: 1-quart of soil; in sealed plastic bags; for soils to be used within the protection zones.

D. Shop Drawings:
   1. Include plans and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones. Indicate extent of trenching by hand or with air spade within protection zones.
   2. Protection-Zone Signage

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

F. 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.

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

H. Survey of Existing Conditions: Provide to Owner a Survey of Existing Conditions. Record existing conditions, including underground utilities, etc. on As Built Drawings by use of field measurements and preconstruction photographs. Make permanent record of measurements, materials, and construction details required to make exact reproduction.

I. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
   1. Species and size of tree.
   2. Location on site plan. Include unique identifier for each.
   3. Reason for pruning.
   4. Description of pruning to be performed.
   5. Description of maintenance following pruning.

J. Record Drawings: Indicate points of disconnection and capping, abandonment and removal of existing utility services; include utility names, sizes and locations, relationship to permanent structures located on site and on adjacent property, and certificates of severance of utility services from respective utility companies or owners.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Approved planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
   1. Type: Wood and bark chips
   2. Size Range: ½’-2”
   3. Color: Natural Brown.

C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:
   1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- OD line posts, and 2-7/8-inch- OD corner and pull posts; with 1-5/8-inch- OD top and bottom rails; with tie wires, hog ring ties, and other accessories for a complete fence system.
      a. Height: 72 inches
   2. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:

1. Text: “Tree Protection Zone. No Heavy Equipment.”
2. Lettering: 3-inch- high minimum, black characters on white background.

E. Tree Branch & Trunck Protection: for branches trunks exposed to, or at risk of exposure to impact by construction equipment.
1. 2x lumber
2. 1/2”-wide steel straps

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas in which work is to be performed. Report in writing to the Owner's Representative all prevailing conditions that will adversely affect the existing plant materials to remain. Do not proceed with work until a solution acceptable to the Owner’s Representative has been arrived at

B. Survey of Existing Conditions: Record existing conditions, including underground utilities, etc. by use of measured drawings and preconstruction photographs.

C. Starting work constitutes acceptance of the existing conditions and the Contractor shall then, at his expense, be responsible for correcting all unsatisfactory and defective work encountered.

D. Install and maintain temporary fencing and other required protective devices and exclude construction activities from tree/shrub zones except as supervised by the Arborist / Owner’s Representative.

E. If access to tree/shrub zones cannot be avoided an intact four inch layer of mulch with minimum 1.25 inch thick, metal strap linked plywood shielding shall be maintained in the tree/shrub zone where heavy equipment will be operated.

F. Locate and clearly flag trees and vegetation to remain or to be relocated, as diagrammed and noted in the Construction Documents.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain an/or relocated. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.

B. Protect tree root 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.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
1. Apply 4-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

D. Install and maintain temporary fencing and other required protective devices and exclude construction activities from tree/shrub zones except as supervised by the Arborist / Owner's Representative.

E. If tree/plant protection zones cannot be protected with fencing, a four inch layer of mulch with minimum 1.25 inch thick, metal strap linked plywood shielding shall be maintained in the tree/shrub zone where heavy equipment will be operated.

3.3 PROTECTION ZONES

A. Protect trees and shrubs against cutting, breaking, skinning and bruising of bark; permit no traffic or stockpiling within drip line.

B. Do not change earth surface within drip line of trees and shrubs except as approved in writing by the Owner.

C. Do not park vehicles or store materials, supplies and construction equipment within Tree Protection Zone.

D. Verify details of protection-zone fencing before retaining last option in "Protection-Zone Fencing" Paragraph below.

E. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
   1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
   2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect. Post may be steel driven type, or self-supporting type.
   3. Access Gates: Install where required; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

F. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet on protection-zone fencing, with signs each facing a different direction.

G. Where tree branches & trunks are exposed to, or at risk of exposure to impact by construction equipment, secure 2x lumber radially around tree branches and/or trunk to prevent damage. Secure lumber with steel strapping.

H. Maintain protection zones free of weeds and trash.

I. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
   2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 CLEARING:

A. Field Verification: Before removing non-designated trees, shrubs, stumps, bushes, vines, rubbish, undergrowth and deadwood as shown on the Drawings and as specified, obtain verification from Owner's Representative.

B. Remove non-designated trees, shrubs, stumps, bushes, vines, rubbish, undergrowth and deadwood as well as fences and incidental structures that interfere with the construction as shown on the Drawings and as specified. Obtain verification from Owner's Representative prior to removal.

3.5 GRUBBING

A. Remove all stumps and roots in their entirety, brush, organic materials and debris to bare earth except where otherwise required. Tree trunks shall be removed minimum depth of 2 1/2 feet below existing grade or finish grade, whichever is deeper.

B. Stump grinding is an acceptable method of removal of roots and stumps of trees and shrubs; however, the chip-contaminated soil shall be replace with approved clean planting soil in planting areas and with approved clean fill soil in all other areas.

C. Backfill and compact voids excavated and open pits and holes resulting from removal operations. Comply with Earthwork Specification for backfill materials, compaction and installation methods. Unless required otherwise, in planting areas backfill holes with clean approved planting soil compacted to 90% relative compaction to a minus 12 inches below finish grade and 85% relative compaction for the top 12 inches, except as required elsewhere to a greater degree by Civil or Structural Engineer. In non-planting areas backfill holes with approved fill soil compacted to 95% relative compaction.

D. When indicated, such materials as topsoil and leaf mold, or other organic materials above the ground surface suitable for use as mulch or topsoil, shall be salvaged and stockpiled.

E. Remove grasses and weeds. Apply systemic weed killer and confirm weed kill prior to removal.

F. Remove existing pavement within proposed planting areas in its entirety, including baserock.

G. Remove existing pavement within proposed pavement areas to a depth sufficient to allow for the construction of the proposed pavement to the grades shown. Existing base material may be left in place and re-compacted as required where not conflicting with the new pavement section.

3.6 UTILITIES

A. Contact local utility companies 48 hours minimum prior to start of demolition work. Confirm verbal notices and written notices. Verify locations of all utilities entering site and their locations on site.

B. Cooperate with the Owner's utility companies, adjacent property owners, and other building trades in maintaining, protecting, re-routing or extending utilities passing through work areas which serve structures located on project site and on adjacent properties.

C. Verify that utilities that are to be removed, capped or abandoned are turned off, or are disconnected, or are re-routed to new locations before starting demolition.

3.7 DEMOLITION/REMOVAL

A. General:
   1. Remove materials in an orderly and careful manner. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover and protect openings to remain.
   2. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
   3. Repair or replace all removal work performed in excess to that required at no cost to the Owner. Repair or replacement shall match and equal construction, condition and finish existing at time of award of Contract.
   4. Removed and Reinstalled Items:
      a. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
      b. Protect items from damage during transport and storage.
      c. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

B. Remove following from locations to the extent required or directed for new construction. Removal of slabs and other structures shall include their footings and foundations. Removal of pavements shall include base rock and sub-structures.
   1. Slabs, equipment pads and sidewalks. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
   2. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
   3. Asphalt, concrete paving, curbs, brick and block.
   4. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
   5. Fencing, including posts, fabric and footings.
   6. Electric utility poles, wires and down guys, including all underground wires and conduits occurring within removal areas.

7. Designated utility services occurring within removal areas, including disconnection, capping and complete removal or abandonment.
8. Buried tanks, complete with piping, footings, leach fields and foundations.
9. Trees and their roots to a minimum of 30 inches below existing grade.
10. Miscellaneous structural elements which interfere with the new construction and as directed by the Owner's Representative.

C. Cutting asphalt, concrete curb and concrete pavement:
1. All lines shall be marked and accepted by Owner's Representative before the cutting operation.
2. Cut edges of pavement at 90-degree angle to the surface in a true and straight line in accordance with dimensions shown on the Drawings. Make cuts with a concrete saw, to a 1-1/2" minimum depth.

D. Backfill and compact areas excavated and open pits and holes resulting from removal operations. Comply with requirements specified in Earthwork, Section 02300 for backfill materials, compaction and installation methods.

E. Rough grade site within removal areas to meet adjacent contours and to provide positive drainage. Leave site in clean condition acceptable for performance of subsequent construction operations.

3.8 EXCAVATION & TRENCHING

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.9 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as approved by certified arborist.

1. Generally cutting of roots two inches or greater shall be avoided. Roots one inch and greater in diameter that must be cut shall be cut cleanly and obliquely with the cut surface facing down.
2. Exposed and pruned roots shall be covered with light well-drained soil backfill and mulch over. The area shall be kept moist.Retain applicable subparagraphs below.
3. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
4. Cut Ends: Do not paint cut root ends
5. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
6. Cover exposed roots with burlap and water regularly.
7. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots 6 inches outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.10 AIR SPADING:

A. Air spading, or hand removal of soil or tunneling is required for excavation in the Tree Protection Zone of any trees for the installation of infrastructure where roots 2 inches in diameter and larger are encountered. The “critical root zone” is defined as any area around a tree in which a two inch diameter root is encountered. The Arborist / Owner’s Representative shall define the critical root zone and the Contractor shall excavate using a pneumatic excavator (AIR-SPADE or equivalent) as follows:

B. Trenching for utility lines or other infrastructure may be done mechanically outside the Tree Protection Zone. As the equipment operator approaches the canopy radius, or for certain species up to 1.5 times the canopy radius out from the base of the tree (Oaks, Poplars, Redwoods, etc.) the operator shall be assisted by a spotter who shall inspect the excavation for roots. If a root of two inches diameter is encountered the spotter shall halt mechanical excavation and pneumatic excavation shall proceed. If no other two inch or greater diameter root is encountered in an excavation of two feet forward and two feet deep, the single two inch root may be cleanly cut proximal to (on the tree side of) any fracture or torn bark. Mechanical excavation may continue until a two inch diameter root is encountered, and the pneumatic excavation, exploration is then repeated.

C. The Contractor shall control dust and the spread of soils excavated. The air-spade operator shall moisten the soil to field capacity and to a minimum probe depth of 2.5 feet with a watering needle (hydro-spear) 48 hours prior to pneumatic excavation. The spread of excavated soil shall be contained to the area adjacent to the trench path with upright plywood sheeting.

D. These specifications shall not be considered operating instructions or a requirement to use a specific pneumatic excavation product. It is the responsibility of the Contractor to read and understand the pneumatic excavator operation instructions and safety procedures (including the proper and safe use of air compressor, hoses, excavation tools, etc.) prior to operations.

3.11 TREE PRUNING

A. Obtain specific instruction from Arborist / Owner's Representative for pruning of trees, shrubs, roots or disturbance of soil within spread of tree branches. The Contractor shall utilize protection measures as outlined by Arborist / Owner's Representative, which may include directional drilling, or hand clearing to expose the roots.

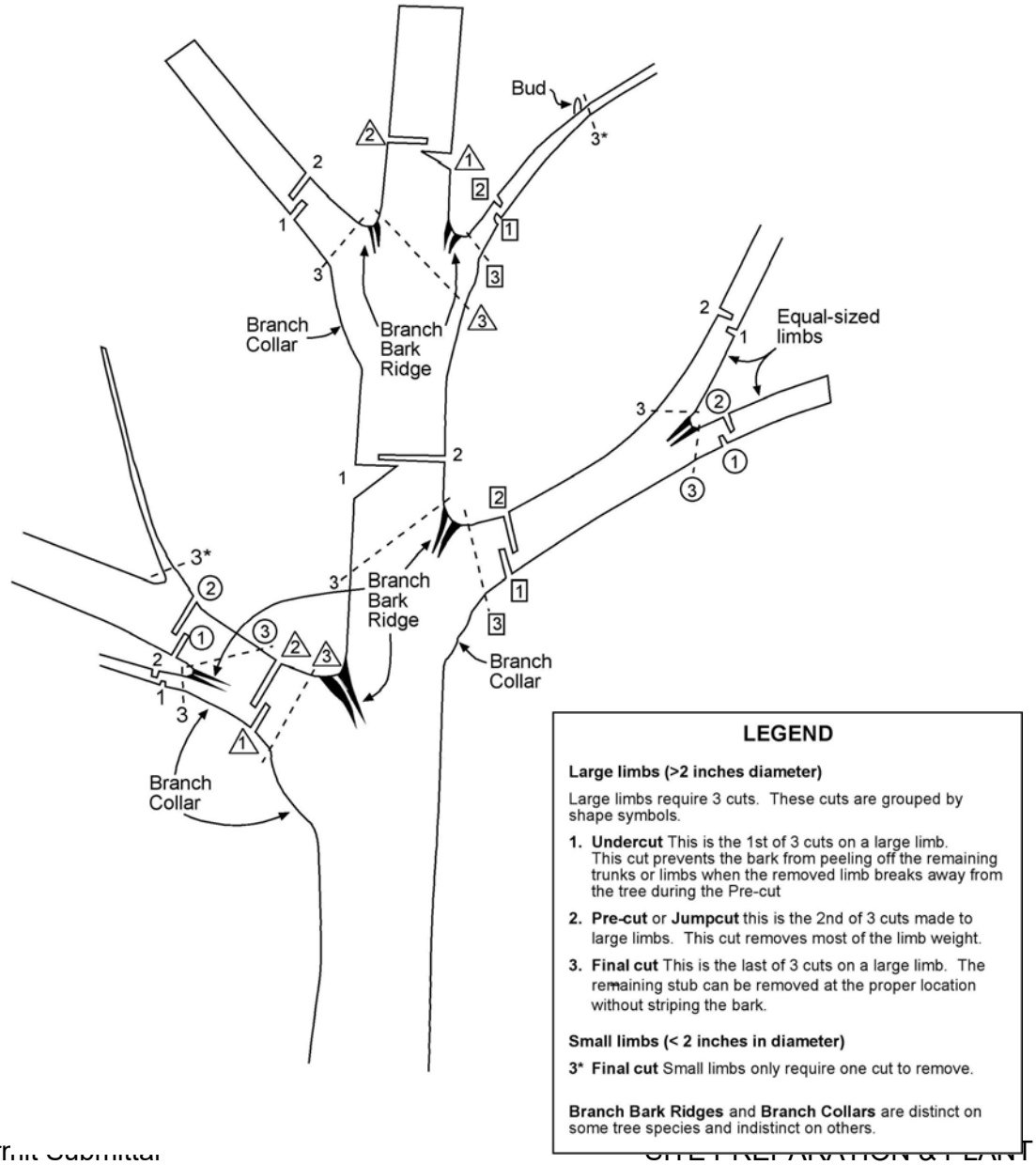
B. Provide periodic watering for all planting within Contract limit and any adjacent areas affected by the work. Maintain moisture to a minimum 6" depth, minimum.

C. Using an approved pruning saw, provide selective tree limb pruning as accepted by the Landscape Architect if branches interfere with new construction. Limb diameter shall be limited to 5” diameter and shall be pruned just outside the branch collar in accordance with American National Standards Institute, (ANSI 300) and International Society of Arboriculture, (ISA) standards.

D. Approved branches to be shortened must be cut just above a fork with another living branch which is plus or minus 1/2 the diameter of the removed branch as shown in the pruning figure herein. Branches to be removed which exceed 2" in diameter shall be severed with a 3-step cut to prevent bark peeling. Final cuts must not injure the branch collar or branch bark ridge of the remaining branches and trunk.

E. Prune branches that are affected by temporary and permanent construction.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees according to ANSI A300 (Part 1)



F. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.

G. Cut branches with sharp pruning instruments; do not break or chop.

H. Do not paint or apply sealants to wounds.

I. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

J. Chip removed branches and stockpile in areas approved by Architect

3.12 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 6inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.13 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.14 TREE & PLANT REMOVAL & REPLACEMENT

A. Field Verification: Before removing non-designated trees, shrubs, stumps, bushes, vines, rubbish, undergrowth and deadwood as shown on the Drawings and as specified, obtain verification from Owner's Representative.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
1. Submit details of proposed pruning and repairs.

2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

C. Backfill and compact areas excavated and open pits and holes resulting from removal operations. Comply with requirements herein and as specified in Earthwork, Section 02300 for backfill materials, compaction and installation methods.

D. Remove all stumps and roots in their entirety. Tree trunks shall be removed minimum depth of 2 1/2 feet below existing grade or finish grade, whichever is deeper. Stump grinding is an acceptable method of removal of roots and stumps of trees and shrubs; however, the chip contaminated soil shall be replace with approved clean planting soil in planting areas and with approved clean fill soil in all other areas.

E. Backfill and compact voids excavated and open pits and holes resulting from removal operations. Comply with Earthwork Specification for backfill materials, compaction and installation methods. Unless required otherwise, in planting areas backfill holes with clean approved planting soil compacted to 90% relative compaction to a minus 12 inches below finish grade and 85% relative compaction for the top 12 inches, except as required elsewhere to a greater degree by Civil or Structural Engineer. In non-planting areas backfill holes with approved fill soil compacted to 95% relative compaction.

F. Remove and replace trees indicated to remain that are more than 25% dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

A. Plant Replacement: Contractor shall replace trees cut or severely damaged due to the Contractor’s work as follows:
1. An ISA Certified Arborist may be retained by the Owner to determine the condition of trees in question as to their ability to survive in a healthy condition and in their original shape, or a pruned aesthetically pleasing shape acceptable to the Owner. Comply with recommendations to rehabilitate as recommended by the Arborist, or to replace in accordance with the requirements below.
2. Trees size shall be determined by Diameter at Brest Height (DBH). Replacement of trees and shrubs shall also include providing acceptable plant installation, automatic irrigation system and a minimum maintenance period of 120 days. If plant(s) is not acceptably maintained and is not healthy and thriving at the end of the 120 day maintenance period, the Contractor shall continue the maintenance work until such time that healthy tree(s) and/or shrub(s) is achieved.
3. Replace any damaged planting in kind using "specimen" plants as follows and at no cost to Owner:
    a. Trees up to 3” DBH: Replace with 36" box size.
    b. Trees 3” to 6” DBH: Replace with 72" box size.
    c. Trees 6” to 12” DBH: Replace with 84" box size.
    d. Trees 12” DBH and larger: Tree value shall be determined by Arborist using Council of Tree and Landscape Appraisers (CTLA) method. Replace damaged tree with largest available nursery boxed tree and cash difference between value of damaged tree and nursery stock replacement cost.
    e. Shrubs: Replace with 15-gallon can size.

4. Plant and maintain new trees as specified

B. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 3-inch uniform thickness to remain.

C. Soil Aeration: Where directed by arborist, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches (300 mm) deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.\

3.15 CLEANUP AND DISPOSAL, per Section 01 70 00.

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Transport trash, rubbish and debris daily from site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove and promptly dispose of contaminated, vermin-infested and dangerous materials encountered.
4. Do not burn or bury materials on site.

B. Clean excess soil may be distributed on site as accepted by Owner's Representative, if it does not adversely affect specified finish grades or percolation of water into planting soil.

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

D. Upon completion of work under this Section, remove all tools, equipment and temporary protections, enclosures and structures.

E. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during site preparation, by methods and with materials so as not to change existing function and warranties.

END OF SECTION

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SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section Includes:
1. Preparing subgrades for slabs-on-grade, walks and pavements, and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Base course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities.

B. Related Sections:
1. Section 31 10 00 – Site Clearing
2. Section 31 23 33 – Trench and Backfilling
3. Section 33 41 00 – Site Storm Drainage Systems

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Geotechnical engineering report “Geotechnical Study Report Dumphy Park Improvements” by RGH Consultants Dated June 9th, 2015

C. Supplemental Geotechnical Recommendations via Email, by RGH Consultants August 15, 2017.

1.3 REFERENCES

A. ASTM: Standards of the American Society for Testing and Materials (ASTM) apply where cited in this Section. Use applicable year of adoption or revision as published in the 2016 “Annual Book of ASTM Standards”.

B. Earthwork materials and methods of construction shall be in accordance with referenced sections of the latest revision of the Standard Specifications of the State of California Department of Transportation (Caltrans), 2015 edition.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled density fill used to fill an excavation

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

D. Drain Rock: Permeable backfill material used for back-of-wall drainage systems and along the bottom of enclosed planters.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without direction by the University's Representative. Unauthorized excavation, as well as all remedial work ordered by the University's Representative, shall be at the Contractor's expense.

F. Fill Material: Soil material used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

A. Submittals will be required for all imported materials to be used in the prosecution of work described in this Section, in accordance with Division 01.

B. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Drain Rock
   3. Warning tapes.

C. In the event that engineered fills must be constructed to complete the work as designed, a representative sample of the material proposed for use shall be submitted to the Geotechnical Engineer for evaluation. If requested, a certified gradation analysis shall also be provided by the Contractor.
   1. The Geotechnical Engineer will make additional inspections as deemed necessary as fill material is brought on site to confirm the material remains

consistent with that originally approved. All rejected materials shall be removed from the site immediately.

1.6 SITE CONDITIONS

A. Contractor shall visit the site and become familiar with job conditions prior to preparing bid.

B. Notify the Owner's Representative when site conditions differ from findings of Geotechnical Investigation Report.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing and earthwork operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the City of Sausalito
   2. Provide alternate routes around closed or obstructed traffic ways if required by the City of Sausalito

D. Existing Utilities: Extra precaution should be taken to identify and protect existing utilities to remain.
   1. Utility Locator Service: Notify utility locator service (Underground Service Alert for utilities located within the public right-of-way, University for utilities located on University property) for area where Project is located before earth moving operations.
   2. Expose existing utilities by hand-excavation or by other method acceptable to by the City of Sausalito or utility provider (for public utilities).
   3. Contractor to notify Owner's Representative if utilities need to be relocated to prevent damage.

E. Do not commence earth moving operations until temporary erosion and sedimentation control measures specified in Section 31 10 00 are in place.

F. The following practices are prohibited within tree and vegetation protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Base Course: Aggregate base for use under asphalt pavements, standard concrete paths, and concrete structures shall be Caltrans Standard Specification Section 26, Class 2 Aggregate Base rock, 3/4" size. Aggregate base materials should consist of virgin rock aggregates only from an established quarry, unless certification can be provided that any proposed recycled materials are free of hazardous and/or deleterious contaminants. The Contractor should provide written certification and supporting test data from a licensed environmental professional stating that the recycled materials are free of hazardous and/or deleterious contaminants.

B. Drain Rock: If required, Drain Rock should consist of Class 2 Permeable Material, meeting gradation and other requirements contained in the California Standard Specifications. Alternatively, three-quarter-inch crushed rock encapsulated in filter fabric (Mirafi 140N, or approved equivalent) may be used instead of Class 2 Permeable Material. The Contractor should provide written certification and supporting test data stating that the proposed drain rock materials meet all the requirements of Caltrans Class 2 Permeable Material. If the Contractor intends to use recycled Class 2 Permeable Material, the same written certification requirement stated above for recycled Class 2 Aggregate Base will apply.

C. Engineered Fill: As per Geotechnical Engineer requirements.

D. Imported Fill: Granular soil, free of organic matter, which does not exhibit excessive shrinkage or swelling behavior when subjected to changes in water content. Imported fill should be free of construction debris. The material should conform to the following:
1. Satisfy the following grading requirements:

U.S. Sieve Size	Percentage Passing (Dry Weight Composition)
2½-inch	100
No. 8	25-45
No. 200	0-10

2. Be thoroughly compacted without excessive voids.
3. Meet the following plasticity requirements:
   a. Maximum Plasticity Index of 6 (ASTM D4318)
   b. Maximum Liquid Limit of 25 (ASTM D4318)
4. Meet minimum R-value of 35 when tested using California Test 301 (at exudation pressure of 400 psi), with a maximum expansion pressure of 100 psf.

I. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

J. Sand: ASTMC 33; fine aggregate natural, or manufactured sand

K. Structural Fill: Caltrans Standard Specification Section 26, Class 2 Aggregate Base rock, ¾-inch size.

L. Pea Gravel: ASTM C 33, Size No 7.

M. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

N. Bioretention (Rain Garden) Soil: Refer to Section 32 91 13 – Soil Preparation.

2.2 GEOTEXTILES

A. Filter Fabric for Infiltration Systems, Underslab Drains and Retaining Wall Drains: Nonwoven geotextile fabric manufactured for subsurface drainage, made from polypropylene fibers, with flow rate range from 110 to 330 gpm/sq. ft when tested according to ASTM D4491.
   1. Structure type: Non-woven continuous filament
   2. Style: Flat
   3. Manufacturer and Model:
      c. TenCate Mirafi 140N.
      d. US Fabrics Inc. US 120NW.
      e. Or equal

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
   1. Blue: Water systems.
   2. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 31 10 00 "Site Clearing."

C. Preparation of subgrade for pervious concrete unit pavers is specified in Section 32 14 00 “Unit Paving.”

D. Protect and maintain erosion and sedimentation controls, which are specified in Section 31 10 00 "Site Clearing," during earthwork operations.

E. Groundwater is present within the proposed excavation depths. Take measures to prevent surface water from entering excavations per recommendations provided in the Geotechnical Report. Contractor to provide Dewatering Plan to Geotechnical Engineer for all Temporary Shoring activities.

F. Notify Geotechnical Engineer at least 48 hours prior to commencing and upon completion of excavations.

3.2 DEWATERING

A. Contractor to provide dewatering according to the Geotechnical Engineer requirements.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with cross sections, lines, and elevations indicated on the Plan.

B. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction.

C. Silt fences shall be installed immediately downslope of all pad excavations to prevent the migration of soils into undisturbed areas. Silt fences shall be maintained and cleaned when necessary until pads have been finished graded, stabilized, and drainage layer installed, and then completely removed by the Contractor.

D. Excavated soils removed from areas of excavation shall be removed from the site and disposed offsite in accordance with all City of Sausalito, and state regulations.

E. Refer to Structural Excavation Section 31 23 00 for requirements for excavation for structures.

3.4 EXCAVATION FOR UTILITY TRENCHES

A. Excavation, bedding and backfill for culverts and structures shall be performed in accordance with the applicable provisions of the Geotechnical Report. All excavations

shall be dewatered to the satisfaction of the Geotechnical Engineer, if necessary, to ensure the stability of the subgrade, bedding and backfill.

B. Excavate trenches to indicated gradients, lines, depths, and elevations.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Refer to Geotechnical Report for specifications of soil type, compaction and layering. Remove projecting stones and sharp objects along trench subgrade.
   1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

D. Pipes and Culverts
   1. The pipe subgrade shall be over-excavated and refilled with mechanically compacted bedding material to provide a base that is 2 inches thick (minimum) below the outside of the subdrain pipe and 6 inches thick (minimum) below the outside of all other pipes. The bottom of the trench shall be shaped so the barrel of the pipe is supported along its entire length and does not bear on the pipe joints. If rock or other unsuitable material is encountered in the trench bottom, the Contractor shall remove additional material as directed by the Geotechnical Engineer and refill to pipe grade with bedding material. All bedding material shall be compacted according to Geotechnical Report
   2. Maintain 6 inches minimum clearance between the pipe and trench walls. If required to stabilize the existing ground, the trench walls shall be braced in conformance with OSHA 29 CFR Part 1926 (Occupational Safety and Health Administration - Excavations: Final Rule). Architect and Engineer take no responsibility for Contractor's shoring operations, including the determination that shoring is required.
   3. Detectable warning tape shall be installed in all pipe or culvert trenches, 6 inches below the bottom of the structural section in concrete or pavement areas and 12 inches below finished grade in lawn areas.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades on the Plans.

3.6 SUBGRADE INSPECTION

A. Notify Owner’s Representative when excavations have reached required subgrade.

B. If Owner’s Representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Owner's Representative.

3.7 SUBGRADE PREPARATION

A. Subgrade Stabilization: At the determination of the Geotechnical Engineer, subgrade stabilization may be required during grading because of 1) wet or soft soil conditions and/or 2) unstable or pumping subgrade. These conditions may occur at the site due to saturated soil or inclement weather conditions during construction. Where such conditions occur, the existing soil should be excavated to a minimum depth of 12 inches. The over excavated area should then be stabilized with geotextile fabric as described below. If stabilization is required, MIRAFI 500X or approved equivalent geotextile fabric should be used. The stabilization should meet the following requirements:
   1. The fabric should be laid loosely on a smooth, fairly level surface; folds and wrinkles in the fabric should be avoided.
   2. Adjacent rolls of fabric should overlap a minimum of 24 inches.
   3. During fill placement, a 9- to 12-inch lift of un-compacted fill should be placed over the fabric before compaction is commenced. Subsequent lifts of fill should then be placed per the requirements described under "Engineered Fill and Backfill Placement".
   4. The fabric should be stored away and protected per the recommendations of the manufacturer.

   Alternatively, the subgrade could be stabilized using lime treatment if the soil materials are amenable to such treatment

B. Unless otherwise specifically stated in this report, any exposed subgrade that will receive fill should be prepared by scarifying to a depth of six inches and moisture-conditioning to a moisture content near optimum moisture content, or as directed by the Geotechnical Engineer. The moisture-conditioned material should then be compacted to at least 90 percent relative compaction (based on ASTM Test Method D 1557), except where subgrade is located directly under concrete walkways and pavement, the subgrade shall be compacted to 95 percent relative compaction. The moisture conditions are to be maintained until subsequent fill is placed.

3.8 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

3.9 STOCKPILE AND REMOVAL

A. Stockpile
   1. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to

prevent windblown dust and additional requirements per Site Clearing Specification.

2. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

B. Removal

1. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them per City of Sausalito requirements

3.10 BACKFILL

A. Place and compact backfill as follows:

1. In areas designated to receive fill, the subgrade-to-receive-fill should be prepared as described under Section 3.7 Subgrade Preparation. Approved fill material should then be placed in lifts not exceeding eight inches in uncompacted thickness, moisture-conditioned to a moisture content near the optimum moisture content of the material, and compacted to at least 90 percent relative compaction (ASTM D 1557).
2. In areas to be overlain by a slab-on-grade, each lift should be compacted, at a suitable moisture content, to a minimum relative compaction of 95 percent in the uppermost six inches of all fill and backfill, and a minimum 90 percent at other depths.
3. In addition to being compacted to the required relative compaction, the engineered fill should also be stable, i.e., not exhibit “pumping” behavior. Ponding or jetting should not be used to densify fill or backfill.
4. Compact structural fill in accordance with Section 31 23 00 – Structural Excavation.
5. Use pea gravel or controlled density material for backfill of footings and pits under structure, where adequate compaction of structural fill cannot be achieved.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud or frost.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill voids with satisfactory soil while removing shoring and bracing.

D. Place and compact initial backfill material to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to a moisture content near the optimum moisture content of the material.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight as per the Geotechnical Engineer's onsite inspection.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements according to the Geotechnical Engineer and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
   3. All areas shall have a positive slope to drain, in accordance with the finished grades shown on the landscape or architectural plans (as applicable), with no low spots.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Walks: Plus or minus 1/2 inch
   2. Pavements: Plus or minus 1/2 inch

C. All graded areas in which no improvements are to be constructed shall be graded and covered with topsoil per the Landscape Architect requirements.

3.14 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Section 33 41 00, "Site Storm Drainage Systems."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 2-inch (minimum) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 8 inches of filter material from outside of pipe and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
   1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D698 with a minimum of two passes of a plate-type vibratory compactor.

3.15 BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place base course on subgrades free of mud or frost.

B. On prepared subgrade, place base course under pavements and walks as follows:
   1. Place base course material under hot-mix asphalt pavement.
   2. Shape base course to required crown elevations and cross-slope grades.
   3. Place base course 8 inches or less in compacted thickness in a single layer.
   4. Place base course that exceeds 8 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 8 inches thick or less than 3 inches thick.
   5. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

A. The Geotechnical Engineer will observe subgrade conditions prior to placement of fill.

B. The Geotechnical Engineer will observe the placement of fill and backfill material.

C. Subgrade Inspection:
   1. Notify Geotechnical Engineer when excavations have reached required subgrade.
   2. In areas showing excessive weaving or pumping, where soft soils are found at the bottom of the excavation or exposed during site preparation, or Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed by the Geotechnical Engineer.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the University's Representative.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas on City of Sausalito property. Stockpile or spread soil as directed by the Owner's Representative.
   1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off City of Sausalito property.

END OF SECTION

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SECTION 31 23 33
TRENCHING AND BACKFILLING

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.

B. Geotechnical engineering report "Geotechnical Study Report Dunphy Park Improvements" by RGH Consultants Dated June 9th, 2015

C. Supplemental Geotechnical Recommendations via Email, by RGH Consultants August 15, 2017.

1.2 SUMMARY

A. Section includes:
   1. Bedding Material
   2. Select Backfill Material
   3. Foundation Rock Fill Material
   4. Controlled Density Fill

B. Related Requirements:
   1. Section 31 20 00– EARTH MOVING
   2. Section 33 14 16 – SITE WATER UTILITY DISTRIBUTION PIPING
   3. Section 33 31 00 – SANITARY SEWERAGE PIPING
   4. Section 33 41 00 – STORMWATER UTILITIES

C. Definitions

1.	Backfill	Material used to fill an excavation.
2.	Bedding	Well-draining material placed on the excavated subgrade in a trench upon which pipes or other elements of the Work is placed.
3.	Dewatering	Removal of all standing water as well as water seeping into an excavation to maintain conditions suitable to continue the Work. Dewatering activities normally include overexcavation and placement of drainrock within an excavation to support required activities and/or equipment. The Contractor is responsible to maintain conditions suitable for the ongoing work. Failure to adequately dewater an excavation or trench may result in project delays.
4.	Foundation Rock Fill	Coarse, well-draining rock used to fill over-excavated areas, particularly in soft soils or where groundwater may be present, to bring the grade up to indicated elevation. Also referred to as "Drain Rock".

5.	Imported Fill	Suitable material that must be transported to the site due to inadequate availability of suitable native fill.
6.	Over-Excavation	Removal of unsuitable material below the design depth of the excavation.
7.	Pipe Zone	The area within a pipe trench wherein the pipe is considered to be particularly vulnerable to external forces. Generally, the pipe zone is described as from the bottom of the bedding layer to approximately an equal distance above the pipe. Upper and lower limits of the pipe zone are indicated on the Drawings and varies depending upon the size and material of the pipe. Where not otherwise indicated, pipe zone extends to one (1) foot above the top of pipe.
8.	Rock Excavation	Solid rock material that cannot be excavated using conventional methods.
9.	Select Material	Non-expansive soil material that is free from organic matter, debris and clumps, stones or clods larger than 3" as described in this Specification.
10.	Springline	An imaginary line through the centerline of a pipe and horizontal to the ground. Also referred to as the haunch of the pipe.
11.	Suitable Material	Soil material that meets the required specifications for its intended purpose as described in this Specification and on the Drawings.
12.	Suitable Native Fill	Native Soil that has been excavated on-site, identified as meeting the requirements for use as a backfill material. It has had all organic material, rocks of unacceptable size, and any other deleterious material removed, and protected from contamination while being stockpiled on site.
13.	Surplus Material	Excavated native material in excess of the project requirements. Surplus Material shall be placed on site in locations and to the grades and compaction requirements of the geotechnical engineer.
14.	Topsoil	The nutrient rich upper layer of soil suitable for landscape plantings. Topsoil material may have organic content per Landscape Specifications.
15.	Trench Zone	The area within a trench above the pipe zone. If no pipe is placed in the trench, the trench zone is the entire trench area.
16.	Unauthorized Excavation	Removal of material, whether suitable or unsuitable material, beyond the excavation limits of the design.
17.	Undisturbed Native Soil	Natural soil material as it exists in situ without being turned, graded, scratched or in any way disturbed.
18.	Unsuitable Material	Any material that does not meet the required specifications for its intended purpose.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)
   1. AASHTO M288 – Standard Specification for Geotextile Specification for Highway Applications

B. ASTM International
   1. ASTM C150 – Standard Specification for Portland Cement
   2. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
   3. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C. CalTrans Standard Specifications

D. Uniform Soil Classification System

1.4 ACTION SUBMITTALS

A. Samples for Verification: For each type of material, provide 1 quart sample (in jar or heavy duty ziplock bag).

1.5 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each soil material used as trench backfill, provide soil analysis by a qualified geotechnical engineer indicating suitability for intended use as described below.

B. Pipe Floatation: Provide calculations to verify the minimum depth above springline of flowable fill required to prevent pipe floatation for all locations, pipe sizes and pipe materials where flowable fill is proposed.

1.6 QUALITY ASSURANCE

A. Contractor shall keep logs of trenching and backfilling activity. Logs will include date, depth, material, means of compaction, moisture content, compaction achieved and any other relevant information to verify satisfactory completion of the Work in accordance with these Specifications.

B. The log shall be signed off by the Supervisor of the Work each day that trenching and backfilling occurs.

1.7 DELIVERY, STORAGE, AND HANDLING

A. All soils materials, stockpiled on site shall be protected from excessive moisture, including from rain or surface sources.

B. All soils materials stockpiled on site shall be protected from erosion and discharge to drainage structures. Soils shall also be protected from wind erosion.

C. Stockpiled materials of different types shall be maintained separately and not allowed to mix.

1.8 FIELD CONDITIONS

A. Weather and Ground Water
   1. The Contractor is responsible for completion of the Work in compliance with these Specifications, regardless of the weather or presence of groundwater.
   2. The Contractor shall review the geotechnical report and any other available sources to understand the potential depth to groundwater.
   3. Water shall not be allowed to enter any open trench to the extent that impacts the integrity of the trench, bottom, bedding or backfill such that requisite compaction cannot be achieved.

B. Safety
   1. It is the Contractor's responsibility to employ adequate and appropriate shoring of trenches.
   2. It is the Contractor's responsibility to safeguard his employees and the public from hazards related to open trenches, per the requirements of Division 01.

C. Underground Utilities and Conflicts
   1. The best available depiction of existing conditions was provided on the Drawings. No guarantee is made that underground utilities, appurtenances or other conflicting obstructions to the Work as shown on the Drawings is accurate or complete. The Contractor is advised to use the provided information with caution and to conduct his own investigation to confirm this information and/or identify any additional conflicts that may exist prior to commencement of the Work.
   2. Should the Contractor identify conflicts that had not been shown on the Drawings or are found to be in a different location than shown, now in conflict with the Work, the Contractor shall immediately notify the Engineer for direction prior to proceeding with the Work.

PART 2 - MATERIALS

2.1 SUITABLE SOIL MATERIALS

A. All soil materials shall be subject to acceptance by the Geotechnical Engineer. Descriptions below may be overridden by the Geotechnical Engineer.

B. Bedding Material
   1. Bedding material shall be clean and free of organic material, debris, clay, cement or other contaminants.
   2. Bedding material for all plastic pipe and any type of pipe less than 6" in diameter shall be clean poorly graded coarse sand free of clay or organic material, meeting the following gradation requirements:

Coarse Sand	
Sieve size	% Passing
No. 4	90-100
No. 200	0-5

3. Bedding material for non-plastic pipe 6" or larger in diameter shall be ¾" Class 2 Aggregate Base (per Caltrans Standard). Material shall be crushed or angular stone that can be compacted to a firm well-draining base. Material shall have a minimum R-value of 78. Material shall meet the following grading analysis:

Class 2 Ag Base	
Sieve size	¾" Max
	% Passing
2"	-
1-1/2"	-
1"	100
3/4"	87-100
No. 4	30-65
No. 30	5-35
No. 200	0-12

C. Pipe Zone Backfill

1. Within the pipe zone, backfill material shall be clean, well-draining, poorly graded material free of clay, silt, organic material or debris.
2. Acceptable pipe zone backfill material includes the following:
   a. Clean Coarse Sand as specified for pipe bedding for plastic pipe and pipes smaller than 6" in diameter.
   b. 3/8" Pea Gravel: Clean, hard, semi-rounded stone, free from clay or organic material with the following gradation requirements:

3/8" Pea Gravel	
Sieve size	3/8"
	% Passing
1"	100
3/8"	95-100
No. 4	0-30
No. 200	0-2

D. Trench Zone Backfill

1. Acceptable Trench Zone Backfill shall consist of clean, non-expansive, compactable soil, being free of clay, organic matter, debris and any clods, stones or other matter larger than 3" diameter.
2. Trench Zone Backfill must meet the requirements of the Geotechnical Engineer, whether specified in the geotechnical report or any other means. No material rejected by the Geotechnical Engineer shall be incorporated into the trench.
3. Trench zone backfill may be suitable native fill or imported fill, provided it meets the requirements of this Specification and is acceptable to the Geotechnical Engineer.

E. Final Backfill
   1. Unless otherwise indicated on the Drawings, the final (top) 12" of fill to finished grade is deemed to be the final backfill zone.
   2. In landscaped areas, final backfill shall be topsoil as indicated on the Landscape Drawings.
   3. In hardscape areas, the final backfill shall meet the requirements of subbase and base required for the relevant pavement section, including compaction requirements that may extend into the trench zone.

F. Foundation Rock Fill
   1. Foundation Rock Fill shall consist of Class 2 Crushed Rock Aggregate Base, per CalTrans Specifications.
   2. At the Contractor's discretion, either ¾" Ag Base or 1 ½" Ag Base is acceptable.

G. Controlled Density Fill (CDF)
   1. CDF shall consist of a fluid, workable mixture of aggregate, cement and water. CDF may be accepted in lieu of sand or granular fill as a nonstructural backfill only upon written approval from the Engineer. CDF shall not be used for structural backfill.
   2. Allowable components of CDF are:
      a. Coarse aggregate in the form of 3/8" pea gravel as defined above under Pipe Zone Backfill;
      b. Fine aggregate in the form of coarse sand as defined above under Bedding Material and shall not form more than 70% of total aggregate content;
      c. Type II portland cement per ASTM C150
      d. Fly ash per ASTM C618.
      e. Air entrainment agent per ASTM C260.
      f. Water shall be free of oils, particulates, chemicals or any other substance which result in any adverse effect on the quality of the backfill material.
   3. CDF components shall be proportioned such that at least 90 lbs. but not less than 180 lbs. of cement are used for each cubic yard of material produced.
   4. Water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.
   5. Entrained air shall be a minimum of 8.0%.
   6. Material shall reach an unconfined compressive strength of at least 50 psi at 28 days.
   7. CDF materials shall be thoroughly machine mixed at a batch plant and delivered to the job site by means of transit mixing trucks. Material tags from the supplier shall be retained and made available to the Engineer upon request.
   8. CDF shall be placed in the Work within one hour after mixing.

2.2 UNSUITABLE MATERIALS

A. Unsuitable materials include the following:
   1. Any material rejected by the Geotechnical Engineer;
   2. Any material classified as CH, MH, OL or OH as defined by the Uniform Soil Classification System.
   3. Any material containing debris, organic matter, large clods, rubble or stones.
   4. Any expansive material or material containing clumps of clay.

2.3 PRODUCTS

A. Underground Pipe Marker

1. As indicated in the relevant pipe specification section.

2.4 SOURCE QUALITY CONTROL

A. Testing Agency: The supplier's certification will be acceptable as verification that the soil material provide by that supplier meets the requirements specified above. In the event that the material properties are in dispute, the Contractor shall engage a qualified testing agency to evaluate soils properties. It is the Contractor's responsibility to provide materials that meet specification and to provide certified validation of the same. Verify testing procedures and certification programs with standards organizations. Verify type of label or stamp provided by standards organization.

B. Any soil material will be considered defective if it does not pass tests and inspections.

C. The Engineer shall retain the soil sample provided by the Contractor for comparison to soils delivered to the job site. Should delivered materials significantly differ in appearance in terms of gradation and/or soils properties, from the sample provided, the material will be rejected. The Contractor may have a new sample tested, at his own expense, to determine if it conforms to the specification. If it is determined to be unsuitable, it shall be immediately removed from the site at the Contractor's expense.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL

A. The following procedures shall be followed by the Contractor in sequencing the Work :
1. No more than one hundred fifty (150) feet of trench shall be left open at any time.
2. The entire trench shall be backfilled, in accordance with this Section, to within fifty (50) feet of the end of pipe or structure at the end of each day.
3. The trench shall not be backfilled until the Engineer has found it to be acceptable.
4. The Contractor shall have a Safety Plan in place that includes protection of workers and the public from falling into the trench, walking or placing equipment or materials close to the edge of an open trench, and provisions for dewatering or shoring as necessary. All Safety measures are the responsibility of the Contractor.

B. Prior to placement in a trench, all pipe, fittings and appurtenances shall be inspected by the Contractor and any defective material shall be rejected.

C. The Contractor shall prepare a clean, protected location for placement of all suitable excavated material. The Contractor shall maintain stockpiles in such a manner to prevent mixing of soil types and to prevent wash, erosion or discharge of soils to surface waters, drainage channels or adjacent properties, whether by water or wind erosion.

D. Trench walls within the pipe zone shall be excavated to be as vertical as possible given the soil conditions.

E. When utility piping is to be installed in fill areas, the fill shall be placed and compacted according to project requirements, then trench is excavated to install pipe. Minimum height of fill shall be placed and compacted to:
   1. Finished grade where wheeled equipment is used for compaction of fill material and utility piping is installed with less than four (4) feet of cover.
   2. Finished grade where hand held equipment is used for compaction of fill material and utility piping is installed with 18 inches of cover or less.
   3. Four (4) feet above top of pipe (when installed) where wheeled equipment is used for compaction, and
   4. Eighteen (18) inches above top of pipe where hand held equipment is used for compaction.

3.3 TRENCH EXCAVATION

A. Obstructions
   1. Obstructions that do not require replacement shall be removed and discarded by the Contractor without additional compensation. Such obstructions may include tree roots, stumps or other organic material, abandoned piping, construction debris, etc.
   2. For obstructions that must be left in place, the Contractor shall provide location and nature of the obstruction to the Engineer, who may authorize alternative alignment, provided it does not adversely affect the Work. Such obstructions may include footings of buildings to remain, trees to be protected, active utility lines, etc.

B. Trench Width
   1. Trenching operations shall be excavated to the width tolerances indicated in the drawings.
   2. Minimum width of trench as indicated shall be maintained in all cases, regardless of size or type of pipe, soil conditions, depth of excavation or method of compaction.
   3. Multiple pipes may only be installed in a common trench under the following conditions:
      a. When installed in a benched trench as detailed in the drawings, and backfilled as indicated;
      b. When backfilled with Controlled Density Fill, care must be taken to anchor the pipe in place to maintain correct vertical alignment.
   4. Under all conditions, the trench width must be such that proper installation of the pipe can be achieved, including:
      a. elimination of point loadings on the pipe,
      b. maintenance of design line and grade,

c. hollowing out sufficient areas for joints, bells, fittings and appurtenances, and
d. adequate compaction of backfill beneath the haunch of the pipe.

C. Trench Depth
1. Unless otherwise noted on the Drawings, all utility piping shall be installed with a minimum of:
   a. 18” of cover in landscape areas, or
   b. 30” of cover in traffic areas.
2. Where it is not possible to achieve the minimum cover described above, the Contractor shallthe Contractor shall provide adequate bridging/protection of the pipe as shown in the Drawing Detail for shallow pipe installation.
3. Trench shall be excavated to a depth sufficient to install the pipe to established grade with adequate compacted bedding provided, per Drawing details and requirements identified by the Geotechnical Engineer.
4. If the Geotechnical Engineer requires over excavation below established grade or alternative or different bedding than identified in the Drawings, the requirements of the Geotechnical Engineer will govern. See the paragraph below on over-excavation.

D. Over-Excavation
1. If the soil conditions at the trench bottom are found to be unsuitable to support the pipe, whether due to presence of water, soft soils, roots or rock protrusions, the Contractor may be required by the Geotechnical Engineer to over-excavate to remove sufficient amounts of unsuitable material to provide sound pipe bedding.
2. Replacement fill material and compaction requirements shall be as directed by the Geotechnical Engineer.
3. The Contractor will not be compensated for excavation beyond the limits specified in the Drawings unless directed to do so by the Engineer in writing and provided with specific limits of the over-excavation.

3.4 BEDDING

A. Unless otherwise specified, all buried utility piping shall be placed on bedding as shown in the Drawings.

B. Bedding shall be placed to the depth indicated on the drawings (in no event less than 4 inches).

C. Bedding shall be compacted to 95% relative density prior to placement of pipe.

D. At the location of bells, flanges, fittings, or appurtenances, the bedding shall be hand excavated to accommodate the shape of the fitting and to allow the full length of the pipe to rest firmly on the bedding or trench bottom.

E. Where native soils are suitable and direct placement of pipe trench bottom is permitted, the trench bottom shall be:
1. Undisturbed native soil or compacted fill;
2. Smooth and flat and excavated to established grade;

3. Free of obstructions or protrusions or sharp edges, remove any obstructions;
4. Completely free of roots or other organic material;
5. Hand excavate the trench bottom at the location of bells, flanges, fittings, etc. to assure the full length of the pipe is in contact with and supported by the trench bottom.

3.5 PIPE INSTALLATION

A. Install pipe, fittings and appurtenances per relevant Specification Section and in accordance with manufacturer's recommendations.

B. Provide support for the pipe as needed to prevent movement and maintain line and grade during placement, installation, testing and backfill. Use non-degradable materials for supporting the pipe if it is to be left in place.

3.6 INSPECTION PRIOR TO BACKFILL

A. The Contractor shall provide adequate opportunity for the Engineer to observe all welds, coatings, polyethylene sleeves, installation of all appurtenances, wall penetrations, vaults and manholes and all other items connected to buried pipelines prior to backfill.

B. Provide minimum 72-hour notice to the Engineer of when pipe installation shall occur.

C. Whenever possible, the installed pipe shall be backfilled the same day that it is installed. Any trench that is not backfilled prior to end of the work day shall be secured with barricades and covering sufficient to bear a minimum of 600 lbs. live load.

3.7 PIPE ZONE BACKFILL

A. Carefully place backfill material on each side of the pipe. Do not drop backfill material directly on pipe.

B. Backfill in low lifts and on both sides of the pipe to prevent shifting the pipe out of alignment. Make sure all voids are filled under the pipe, vibrating or hand compacting material in small lifts as appropriate.

C. Bring backfill material up to the springline on both sides of pipe and carefully compact evenly on both sides of pipe before backfilling above springline.

D. Complete backfilling within pipe zone, as shown on Drawings, by carefully placing backfill material on either side of pipe in low lifts and hand compacting until backfill of pipe zone is complete.

3.8 FLOATATION

A. In conditions where high groundwater may exist, precautions shall be taken to avoid floatation of pipes. High groundwater potential may not be evident during the construction period.

B. Provide appropriate anchorage for pipes which may include:
   1. Mass concrete backfill above the springline
   2. Controlled Density Fill as backfill above the springline
   3. Other solution as recommended by the Geotechnical Engineer.

C. The Contractor shall submit the proposed anchorage method to the Engineer for approval, including buoyancy calculations that indicate minimum depth of fill, buoyant forces and safety factor used to calculate anchorage system, all products to be used in anchorage system and assumptions.

D. Where flowable backfill is used in the pipe zone, it:
   1. shall be placed evenly on both sides of the pipe,
   2. it shall be not be placed below the springline unless approved anchorage is employed to prevent floatation during backfill.

3.9 TRENCH ZONE BACKFILL

A. Once backfill is complete within the pipe zone, trench zone backfilling shall commence.

B. Trench zone backfill shall consist of any suitable fill material that can be compacted to 90% relative density.

C. Backfill shall be gently placed in maximum 8” lifts and compacted by hand methods until three (3) feet of cover has been achieved.

D. Once three (3) feet of cover has been achieved, compaction may be completed in the trench zone using wheeled equipment.

3.10 FINAL BACKFILL

A. The final backfill, as indicated in the Drawings, consists of the top layer of soil or material to achieve finished grade.

B. In landscape areas, topsoil or other material required for landscaping areas shall be placed for the top layer of soil to a depth as indicated in the Landscape Drawings.

C. In paved areas, the final lift of soil shall be compacted to minimum 95% relative density. Sub-base and base material as indicated in the Drawings shall be placed and compacted and indicated pavement placed to finish grade.

END OF SECTION

SECTION 32 12 12
ASPHALT PAVING

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.

B. Geotechnical engineering report "Geotechnical Study Report Dumphy Park Improvements" by RGH Consultants Dated June 9th, 2015

C. Supplemental Geotechnical Recommendations via Email, by RGH Consultants August 15, 2017.

1.2 SUMMARY

D. Section Includes:
   1. Hot-mix asphalt paving and patching within vehicular travel areas on Owner property.
   2. Hot-mix open-graded asphalt concrete mix for porous asphalt pavement.

E. Related Sections:
   1. Section 31 10 00 – Site Clearing
   2. Section 31 20 00 – Earth Moving

1.3 REFERENCES

A. ASTM: Standards of the American Society for Testing and Materials (ASTM) apply where cited in this Section. Use applicable year of adoption or revision as published in the 2009 "Annual Book of ASTM Standards".

B. Earthwork materials and methods of construction shall be in accordance with referenced sections of the latest revision of the Standard Specifications of the State of California Department of Transportation (Caltrans), 2010 edition.

1.4 DEFINITIONS

A. Hot-mix asphalt paving terminology: Refer to ASTM D 8 for definitions of terms.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Filter fabric

C. Standard hot-mix asphalt mix designs (for both standard and porous hot-mix asphalt) and testing data demonstrating adherence to the requirements stated within these specifications and plans.

1.6 QUALITY ASSURANCE

A. Contractor shall repair or restore to first class conditions any portion of the asphaltic paving in which weed growth, creeping, shoving, revealing, cracking, softening, excessive or uneven settlement due to improper placing, or defective materials that appear or become apparent within one (1) year from date of acceptance.

B. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by Caltrans.

C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the City's Construction Standards and Caltrans Standard Specifications requirements for asphalt paving work.

E. Test Panels (Porous Asphalt Pavement): The Engineer uses authorized test panels as the standard when evaluating the texture and color of the pavement surface.

Before paving operation starts, construct test panels at the jobsite. Use the materials, tools, equipment, personnel, and methods you will use in the work. Construct at least 2 test panels. Each panel must be at least 225 sq ft.

If the Engineer rejects the test panels, construct new test panels.

Obtain authorization of the test panels before placing other porous asphalt pavement.

Remove and dispose of rejected test panels. Authorized test panels must remain in place until all porous asphalt pavement is completed. If authorized test panels are not constructed within the limits shown for porous asphalt pavement, remove and dispose of them.

Remove and dispose of rejected test panels. Authorized test panels must remain in place until all porous asphalt pavement is completed. If authorized test panels are not constructed within the limits shown for porous asphalt pavement, remove and dispose of them.

F. Infiltration Rate: Test the infiltration rate of the completed porous asphalt pavement test panels under ASTM C1701. Perform 3 tests in areas up to 25,000 sf. Conduct one test for each additional 10,000 sf. Separate each test locations by at least 20 ft. Do not perform tests (1) if there is standing water on the pavement surface or (2) less than 24 hours after 1/4 inch or more of rain. The infiltration rate must be at least 500 inches/hour.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations. Aggregates shall conform with the Caltrans Standard Specifications and the Geotechnical Report.

B. Aggregate shall conform to the required gradations stated in Caltrans section 39-1.02E:

C. Standard Asphalt Pavement shall use gradations indicated for ½" Type A hot-mix asphalt (HMA).

D. Porous Asphalt Pavement shall use gradations indicated for ½" Open Graded Friction Course (OGFC) HMA.

2.2 ASPHALT MATERIALS

A. Pavement Binder:

B. Standard Asphalt Pavement: PG 64-10 grade liquid asphalt.

C. Porous Asphalt Pavement: PG 76-22 grade liquid asphalt.
1. Reinforce aggregate/asphalt mixture with mineral or cellulose fibers, at an application rate as determined by the HMA supplier.

D. Tack Coat: RS-1 asphalt emulsion, in accordance with Caltrans Section 94.

E. Water: Potable

F. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.3 AUXILIARY MATERIALS

A. Sand: AASHTO M 29, Grade Nos. 2 or 3.

B. Joint Sealant: Per Caltrans Standard.

C. Paving Geotextile (if required by Geotechnical Engineer): Mirafi 500X or approved equivalent.

D. Impermeable Liner: US Fabrics 60 mil HDPE – Textured or approved equivalent.

2.4 MIXES

A. Hot-Mix Asphalt: Design to be prepared by supplier and submitted for approval, in conformance with requirements set forth Section 39-1.03 of Caltrans Standard Specifications for both standard asphalt and porous asphalt applications.

B. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

C. Mix design shall be suitable for H-20 vehicle loading and minimum 16,000 pound individual wheel loads, total loads of 65,000 pounds**.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement base materials are dry and in suitable condition to begin paving.

B. Proof-roll the prepared base with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated bases.

C. Completely proof-roll the base in one direction. Limit vehicle speed to 3 mph.

D. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as identified by the Contractor or as determined by the Owner's Representative, and replace with compacted aggregate base in non-porous pavement areas and with choker course rock in porous pavement areas.
   1. Note that Contractor retains responsibility for all pavement constructed over soft or otherwise unsatisfactory soils.

E. Proceed with paving only after unsatisfactory conditions have been corrected.

F. Notify the Owner Representative in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Geotechnical Engineer and the Owner Inspector.

3.2 PATCHING WITHIN PUBLIC RIGHT OF WAY

A. Excavation: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade at a depth as required to construct the patch in accordance with the Plans.

B. Place and compact additional aggregate base, as directed in Section 31 20 00, if required to raise subgrade to the proposed pavement base elevation.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..

D. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

E. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

F. Patching: Place standard hot-mix asphalt in fully compacted lifts not less than 1 inch and not more than 3 inches in compacted thickness. The completed patch shall be finished flush with adjacent surfaces.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

B. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

C. Crack and Joint Filling:

D. Clean cracks and joints in existing hot-mix asphalt pavement.

E. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

F. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared pavement base is ready to receive paving.

B. Tack Coat: Apply uniformly to surfaces of existing pavement being overlaid and to all vertical surfaces with which the asphalt pavement will come in contact (curbs, manholes, drain inlets, etc.) at a rate of 0.05 to 0.15 gal./sq. yd.

C. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

D. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 HOT-MIX ASPHALT PLACING

A. Section applies to the placement of both standard hot-mix asphalt and porous hot-mix asphalt.

B. Contractor shall demonstrate satisfactory experience with the placement, compaction and finishing of porous hot-mix asphalt pavements.

C. Machine place porous asphalt on prepared surface, spread uniformly, and strike off. Place mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

D. Place hot-mix asphalt in number of lifts and thicknesses indicated.

E. Spread mix at minimum temperature of 250 deg F.

F. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

G. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

H. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

I. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete each lift of asphalt pavement before placing subsequent courses.

J. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

B. Complete compaction before mix temperature cools to 185 deg F.

C. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

D. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

E. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

F. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

G. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

H. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

I. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with full depth lifts of fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

J. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

K. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

B. Base Course(s): Plus or minus 1/2 inch.

C. Surface Course: Plus 1/4 inch, no minus.

D. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

E. Base Course: 1/4 inch.

F. Surface Course: 1/8 inch.

G. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

H. Pavement Surface Gradients:

I. Pavement gradients shall not exceed accessibility code requirements for maximum longitudinal and cross-slopes per the Plan.

J. Pavement gradients shall not be less 1%.

K. Contractor shall notify Owner Representative if minimum and/or maximum slopes cannot be achieved as indicated on the Plans prior to further pavement installation.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections as required.

3.9 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION

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SECTION 32 13 12
SITE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide Portland cement concrete site work complete, including the following principal items:
   1. Retaining walls, stairs, seat walls, etc
   2. Curbs, walks and pavements, including aggregate bases.
   3. Footings for posts and structures.
   4. Curb ramps per ADA Requirements

B. Related requirements specified elsewhere include:
   1. Section 31 20 00, EARTH MOVING
   2. Section 32 17 26, DETECTABLE WARNING SURFACES
   3. Section 33 41 00, STORM UTILITY DRAINAGE PIPING

1.2 QUALITY ASSURANCE

A. Reference and Standards
   1. Geotechnical Study Report by RGH Consultants, dated June 9, 2015.
   2. Perform work in accordance with all applicable laws, codes and regulations required by the City of Sausalito.
   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. The American Concrete Institute (ACI): “Recommended Practice for Concrete Formwork” (ACI 347R)
   6. The American Concrete Institute (ACI): "Hot Weather Concreting", 305R-99
   7. The American Concrete Institute (ACI): Guide for Concrete Slab construction, 302.1R-07
   8. The American Concrete Institute (ACI): "Standard Specification for Cold Weather Concreting, 306.1-90 (R2002)
   9. United States Voluntary Product Standard for Construction & Industrial Plywood (PS 1-95).
   10. American Plywood Association’s “Guide to Plywood Grades” (APA).
   11. West Coast Lumber Inspection Bureau’s “Standard Grading Rules No. 17” (WCLIB)
   12. Concrete Reinforcing Steel Institute (CRSI): “Manual of Standard Practice” and “Recommended Practice for Placing Reinforcing Bars”.
   13. American Welding Society: AWS A5.1 and AWS D1.1 and D1.2.
   14. Americans with Disabilities Act (ADA), Federal ADA/State of California Title 24 Standards.
   15. California Code of Regulations, Title 24, 2010 Edition, also known as California Building Code (CBC).

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. Finish Concrete Surface Slip Resistance: Shall have a minimum slip resistance coefficient of 0.65 on concrete pavement with less than 5% slope and 0.8 on concrete pavement with more than 5% slope.
   4. Walls retaining soil that retain 30 inches or more of soil shall include a subsurface drain behind wall per Section 68 of the Standard Specifications and as accepted by the Owner's Representative. Drain line shall be connected to storm drain system as accepted by Owner's Representative.
   5. Walls retaining soil that retain 18 inches or more of soil shall receive Dampproofing per Caltrans Standard Specifications, Section 54.
   6. Contractor shall pour adjacent slabs in a way that does not impact finish quality or construction (expansion) joint dimensional stability.

C. Testing and Inspection, per Section 01 45 00.

D. Conform to ACI 318, Section 5.13 during hot weather and to ACI 318, Section 5.12 during cold weather.

E. Requirements of ACI 318 shall govern work, materials and equipment related to this Section; specifications herein set minimum results required, and references to procedures are intended to establish minimal guides.

F. The Contractor shall be responsible for quality of concrete in place and shall bear burden of proof that concrete meets minimum requirements. Contractor shall confirm that site soils do not contain elevated levels of sulfate that would require sulfate resistant concrete as outlined in Table 4.3.1 of the ACI 318 Building Code or Table 19B-A-3 of the Uniform Building Code. If the site soils contain elevated levels of sulfate, it is the Contractor's responsibility to request mixes that meet the aforementioned requirements.

G. Placing of concrete by means of pumping will be an acceptable method of placement providing that the Contractor can demonstrate that:
   1. Specified concrete strengths will be met.
   2. Equipment has a record of satisfactory performance under similar conditions and using a similar mix.
   3. Trial batches have been successfully made.

H. Installer Qualifications: Concrete work shall be by firm with 5 years experience with work of similar scope and quality.

I. Formwork Design Criteria: Formwork shall conform to ACI 318, Section 6.1 and CBC Section 1906A.
   1. Formwork:
      a. Shall prevent leakage or washing out of cement mortar.
      b. Shall resist spread, shifting, and settling.
      c. Shall reproduce accurately required lines, grades and surfaces within tolerances specified.
   2. Safety: The Contractor shall be responsible for adequate strength and safety of all formwork including falsework and shoring.

3. Formwork allowable tolerances: Formwork shall produce concrete within tolerance limits recommended in ACI 318, Section 6.1, unless otherwise noted.

1.3 TESTS

A. The Owner will select a qualified testing laboratory to take samples for testing during the course of the work as considered necessary. Costs for such tests will be paid by the Owner. Contractor shall cooperate in arranging 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 Owner. Full cost of removal of low strength concrete, its replacement with concrete of proper specified strength and testing, shall be borne by Contractor.

1.4 COORDINATION

A. Coordinate items of other trades. Contractor shall be responsible for the proper installation of all accessories embedded in the concrete and for the provision of holes, openings, etc., necessary to the execution of the work of the trades.

1.5 SUBMITTALS, per Section 01 33 00.

A. Samples of all materials under this Division shall be supplied for testing as requested by the Owner.

B. Material certificates in lieu of material laboratory test reports when permitted by Engineer. Material certificates shall be signed by manufacturer and Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.

C. Submit color additive manufacturer’s color chart and sample chip(s), indicate color additive number and required dosage rate.

D. Submit two full-scale mock-up (minimum 4’ by 4’) sample panels of all concrete finishes and color. The samples shall include curing compound if any is to be used, and include an expansion joint and a score joint, as indicated on the Drawings. Approved samples shall be kept at the job site to serve as a prerequisite for all finishes until acceptance of the Work.

E. Submit one pint samples of aggregate for exposed aggregate finished concrete paving in color range as specified.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Supply ready mixed concrete throughout. Batch, mix and transport in accordance with ASTM C-94, "Specifications for Ready Mixed Concrete."

B. Mix and deliver concrete in quantities that will permit immediate use only.

C. Indiscriminate addition of water for any reason will be cause for rejection of the load.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Cement and aggregates shall have proven history of successful use with one another. Sources of cement and aggregate shall remain unchanged throughout work.

B. Mixes:
1. Ready-mixed concrete shall meet requirements of ASTM C94.
2. The Contractor shall perform tests or assemble the necessary data indicating conformance with specifications.
3. For each mix, submit data showing that proposed mix will attain the required strength in accordance with requirements of Caltrans Standard Specifications, Section 90.
4. Instruct Laboratory to base mix design on use of materials specified and approved by the Owner's Representative.
5. Mix design shall include compression strength test reports per CBC Section 1905A.6.3.
6. Insure 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. Introduction of calcium chloride will not be permitted.
9. Mix design shall be in accordance with CBC Section 1905A.3.

C. Concrete Types (See Drawings for any other miscellaneous items not listed below):

TYPE	28-DAY STRENGTH	AGGREGATE SIZE	FINISH & COLOR	COMMENTS
Slab on grade	3,000	1" X #4	See Drawings	
Seat Walls	3,000	1/2" X 1/4"	See Drawings	
Curb & Gutter	3,000	1" X #4	See Drawings	

2.2 FORMWORK MATERIALS

A. For Exposed Smooth Form-finished Concrete: Use Medium Density (or better) Overlaid Concrete Form Exterior (MDO), to provide continuous straight, smooth, exposed surfaces without grain patterns. Furnish in largest practicable sizes to

minimize number of joints and to conform to a joint system as approved by Owner's Representative.

B. Curbs may be formed with approved metal form systems.

C. Form Release Agent: Must not stain or otherwise adversely affect architectural concrete surfaces. "Nox-Crete Form Coating"; Industrial Synthetics Corp.'s "Synthex"; or equal.

D. Form Ties: Burke "Penta-Tie," or equal, cone and rod type with 1-inch break-back.

2.3 REINFORCING MATERIALS

A. New, free of rust, Billet steel bars: Current ASTM designation A615.

B. Bar Reinforcement: ASTM A615.
   1. #3 and smaller: Grade 40.
   2. #4 and larger: Grade 60.
   3. Tie wire: #6 minimum, black and annealed.

C. Bar Reinforcement recycled content shall be a minimum of 75% recycled post consumer steel.

D. Wire Fabric Reinforcement: ASTM A185. Size (6" by 6" / W1.4 By W1.4 (#10 ga. by #10 ga.)

E. All reinforcing steel, bolts anchors, sleeves, etc. shall be securely anchored in place before concrete is placed. All reinforcing details, fabrication and installation shall conform to ACI Standard 315, latest edition, except as noted. Stagger all splices where practical and not otherwise detailed. Minimum concrete protection for reinforcement shall be as follows unless otherwise noted:
   1. 3" clearance where concrete is placed against the earth.
   2. 2" clearance where concrete is exposed to earth but placed in forms.

F. Accessories: Metal and plaster spacers, supports, ties, etc. as required for spacing, assembling and supporting reinforcing in place. Legs of accessories to be of type that will rest on forms without embedding into forms. Galvanized metal items where exposed to moisture, or use other approved non-corrodible, non-staining supports.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type II, except if water or soil is high in sulfates use Type V Portland Cement as described above under Quality Assurance. Use one brand of cement throughout project.

B. Fly Ash: ASTM C618,08A.

C. Aggregates: ASTM C33, materials from established sources with proven history of successful use in producing concrete with minimum shrinkage.

D. Aggregate for seeded aggregate finish paving shall consist of 3/8" smooth, hard, fine-grained clean, river run pea gravel mix aggregate. Submit samples for approval as specified herein.

E. Aggregate for washed exposed aggregate finish paving shall consist of 3/4" by #4 smooth, hard, fine-grained clean, river run aggregate. Submit samples for approval as specified herein.

F. Water: Clear and potable, free from deleterious impurities.

G. Admixtures:
   1. Admixtures are optional; however, a water reducer or plasticizing admixture shall be included in the concrete mix and it must be compatible with color pigments where color pigments are required. Any proposed admixture shall comply with ASTM C494.
   2. Where more than one admixture is proposed, include statement from admixture manufacturer indicating that admixtures proposed for use are compatible, such that desirable effects of each admixture will be realized.
   3. Accelerating admixtures and admixtures containing more than 0.05 percent chloride ions are not permitted. If an accelerator is used, it shall be an non-chloride accelerator.
   4. Liquid admixtures shall be considered part of the total water.
   5. Refer to Color Additives/Pigments herein for color admixtures.

2.5 CONCRETE MIXES

A. Concrete mixes shall be approved and shall be in accordance with Caltrans Standard Specifications Section 90. Unless otherwise noted, mix shall contain not less than 590 pounds of cementitious material per cubic yard (Class "2", 3,000 psi,) Type II Portland cement and a maximum aggregate blend of 1" by #4.

B. Cementitious Material: An intimate blend of type II Portland cement and fly ash. Cementitious material shall include 15% maximum fly ash by weight unless the strength is specified to be achieved on 7 or 14 days.

C. Lampblack: As supplied by batch plant for plain non-colored concrete work. Concrete for non-colored pavements shall be darkened by the addition of lampblack at the mixer. The proportion of lampblack or other approved colorant shall be that required to properly darken the concrete to reduce glare, and shall be subject to the approval of the Owner's Representative. Provide ¾ pound of lampblack per cubic yard of concrete unless required otherwise.

2.6 SPECIAL AGGREGATE FOR EXPOSED AGGREGATE FINISHES

A. Aggregate for exposed aggregate finished concrete paving shall be smooth, river-washed hard durable aggregate in a color range as accepted by the Owner’s Representative

2.7 ANCILLARY MATERIALS

A. Aggregate Base: Crushed aggregate, R-78 minimum, 3/4-inch maximum, conforming to Standard Specification 26.1.02A, Class 2.

B. Expansion Joint Material
   1. Fiber Expansion Joint: A non-extruding resilient filler, saturated with high quality bituminous materials having preserving characteristics. Conform to ASTM-D1751-04.

C. Dampproofing: Per CALTRANS Standard Specifications, Section 54.

D. Subsurface Drain behind Retaining-Type Walls: All concrete walls that retain 30 inches of soil or more shall include a subsurface drainage system to relieve water pressure in accordance with Section 68 of the CALTRANS Standard Specifications and as shown. If no subsurface drain is shown, provide corrugated polyethylene plastic tubing per 68-1.02K surrounded with an envelope of Class 2 permeable material in conformance to Section 68 "Subsurface Drains" of the Standard Specifications, 3/4 inch maximum without fines and wrapped with filter fabric per 68-1.028. Provide black colored rodent-proof slotted cap over exposed outfalls as accepted by Owner's Representative.

E. Curing Materials for non-colored Concrete:
   1. Waterproof Paper: ASTM C171, Type 1.1.1.1, regular. Same as Sisalkraft Division of St. Regis Paper Co.'s "Orange Label", or equivalent.
   2. Impervious sheeting: 4 mil white polyethylene laminated to 10 oz. Burlap, ASTM C171, Type 1.1.3, fungus-resistant.
   3. Curing Compound: ASTM C309. Product: Sealtight 1100 Clear-Series by WR Meadows, Burke Azua Resin Cure by Edocol, or equal that will not discolor concrete or affect bonding of other finishes applied thereafter, and which restricts loss of water to not more than 0.500 grams per sq. centimeter of surface when tested per ASTM C156, "Test Method for Water Retention by Concrete Curing Materials."

F. Grout: Premixed high strength non-shrink grout requiring only addition of water at the site. Burke's "Non-Ferrous, Non-Shrink Grout"; Master Builders "Masterflow 928 Grout", or equal.

G. Patching Mortar: Mix in proportions by volume of one part cement to two parts fine sand. Provide integrally colored patching mortar as required to match color and finish of colored concrete surfaces.

2.8 PERFORATED DRAIN PIPE

A. Polyvinyl Chloride (PVC) pipe and pipe fittings shall meet extra strength minimum of SDR-35 of the requirements of ASTM Specification D3034.

B. Perforated and non-perforated corrugated polyethylene pipe, 3- to 10-inch diameter, shall meet the requirements of ASTM D883 and ASTM F412, and shall conform to Section 68 of the Standard Specifications.

C. Corrugated polyethylene pipe fittings shall comply with all requirements of AASHTO M-252-85I for 3- to 10-inch diameter pipe. Couplings shall be split or snap-on type for perforated pipe and split couplings with gaskets for non-perforated pipe. Cutting pipe with integral couplings will not be allowed.

D. Corrugated polyethylene pipe and fittings manufactured by Advanced Drainage Systems, Inc., shall be considered the standard to determine compliance to this specification.

E. Inspection Tube Cap: Paint cap one coat chocolate-brown color using Flat, exterior grade latex paint as accepted by Owner's Representative.

2.9 FILTER FABRIC / PERMEABLE LANDSCAPE FABRIC

A. Polyester or polypropylene non-woven filter fabric with uniform fiber distribution by "Terra Bond" #1115, "Mirafi, Inc." #140N, or approved equal.

2.10 PERMEABLE DRAIN ROCK

A. Permeable drain rock used in subsurface drain installations to be Class 2 permeable material in conformance with Section 68 "Subsurface Drains" of the Standard Specifications; gradation to 3/4" maximum size. Submit Sample for approval.

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 Owner's Representative.

C. Plain non-colored, exposed concrete shall contain lampblack, approximately 3/4 pound of lampblack per cubic yard, as accepted by Owner’s Representative.

D. The intent of the Grading Drawings is to provide positive drainage and to maintain slopes on walkways as required by the Americans with Disabilities act and California Title 24 throughout the project site. Notify the Owner's Representative immediately of any discrepancies between the Drawings and actual field conditions and/or conflicts between the design and Code requirements.

3.2 PREPARATION

A. Subgrade preparation and compaction to be performed as required by geotechnical engineer and per recommendations outlined in geotechnical report.

B. Examine subgrades and installation conditions. Do not start concrete work until unsatisfactory conditions are corrected.

C. Provide subgrade preparation and the base material installation complete, including clearing, grading, excavation, filling and dewatering. Take every precaution to obtain a subgrade of uniform bearing power compacted to a minimum of 95% relative compaction as determined by the ASTM D1557 laboratory test procedure and in Sections 19 and 20 of the Caltrans Standard Specifications.

D. Subgrade shall be kept moist and shall not be allowed to dry out before placement of concrete. Place no material on muddy subgrade. Remove un-compactable material and replace with clean fill and compact as required.

E. Aggregate base, where indicated, shall be placed and compacted in conformance with Caltrans Standard Specifications 26-1.04 and 26-1.05.

F. Obtain approval of subgrade from Owner's Representative prior to placing steel and concrete.

3.3 FORMS

A. Forms shall be constructed in accordance with ACI 318, Section 6.1 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 constructed 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 approved by the Owner’s Representative.

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 and pavement edge forms shall extend full depth of concrete and shall be coordinated with installation of planting root barriers where required. 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. Where curbs and pavement are adjacent to areas to receive root barriers, provide smooth uniform edges. Remove any excess concrete as required to allow installation of root barriers without gaps between curbs and/or pavement and barriers.

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. Form Ties: Align form ties as accepted by Owner’s Representative. Obtain approval of form work from Owner's Representative 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. Walls and benches: 48 hours.
   2. Footing sides: 24 hours.
   3. Curbs: 1 hour

3.4 REINFORCEMENT

A. All concrete footings, walls, grade-beams 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 or as accepted by Owner's Representative.

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 approved 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 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, mismatched color, or is otherwise defective, and , in the Owner’s Representative’s judgment, these defects impair proper strength or appearance of the work, the Owner’s Representative 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 colored and textured to match concrete. 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 Owner’s Representative deems rock pocket too large for satisfactory mortar patching as described, cut out defective section to solid surface, and replace.

E. Cleaning

1. Insure removal of bituminous materials, form release agents, bond breakers, curing compounds, if permitted and other materials employed in work of concreting that 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.

3.6 MIXING AND PLACING CONCRETE

A. Conform to applicable requirements set forth in Caltrans Standard Specifications Section 51-1.09 and Section 90.

B. Mixes for integrally colored concrete shall have pigment added early enough to ensure complete dispersal and uniform color, but not less than 15 minutes before placing.

3.7 JOINTS AND GROOVES IN FLAT WORK

A. Plane of joints shall be perpendicular to surface. Where new pavements join existing, joints shall align.

B. Tooled Joints / Score Joints
1. Form joints in fresh concrete using a jointer to cut the groove so that a smooth, uniform impression is obtained to 1/4 depth of pavement unless shown otherwise.
2. All joints shall be struck before and after brooming. Tool concrete both sides of joint.
3. If joint pattern is not shown, provide joints not exceeding 6 feet in either direction and located to conform to column centerlines, wall corners, etc. as accepted by Owner’s Representative.

C. Expansion Joints in Flat Work: Provided at the location and intervals as shown on the drawings, and at all locations where concrete paving abuts buildings, curbs, walls, columns, or other structures, and not more than 16 feet on center. Specified and shown joint material shall be placed with top edge 1/8" below 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, expansion joints shall be carefully cleaned and filled with approved joint sealant to just below adjacent paved surface in such a manner as to avoid spilling on paved surfaces or overflowing from joint.

3.8 JOINTS AND GROOVES IN WALLS

A. Provide control joints (weakened plane) in walls as show on Drawings, and not to exceed 16 feet on center. Provide "V"-type control joint both sides of wall opposite one another and connected across the top unless shown otherwise. If V joint is omitted on top of wall, add bridging rebars to reduce cracking as accepted by Owner's Representative.

3.9 TOOLED SCORING AND FINISH OF CONCRETE TREADS

A. General: Provide field scoring of all exterior stair treads, including edges of slabs adjacent to the highest tread in a run of stairs at floor levels and intermediate landings.

B. Layout: Provide matching pattern at all locations, including setback from nosing, setback at sides and width, score depth, and scoring pattern.
   1. Setback from Nosing: 1-inch maximum.
   2. Setback from Sides: 2 inches maximum.
   3. Overall Width including setback from nosing: 4 inches.
   4. Spacing of Score Lines: 1/2-inch on center maximum.
   5. Depth: 1/8-inch minimum.

C. Finish: Medium broomed lengthwise for a non-slip finish.

D. Step Striping: Prepare surfaces per manufacturer's recommendations (At a minimum, remove dirt, grease loose mortar, scale, salts, alkalies, and other detrimental substances with solution of trisodium phosphate, acid etch, and rinse with clear water and allow substrate to dry).Paint the scored area with contrasting colored masonry paint, black color unless required otherwise. Paint stripe shall be neat and uniform and shall be at least as slip resistant as the pavement surface.

3.10 FINISHING

A. Flatwork and Curbs
   1. 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 (sidewalks): Obtain by drawing a stiff bristled broom across a floated finish for a nonslip surface. Perform brooming while concrete is still wet enough to receive broom marks to match approved sample. Direction of brooming to be perpendicular to direction of work or as otherwise shown on the drawings.
      c. Brush Finish (typical for curbs): After the front form is removed, exposed surface shall be troweled smooth and then given a uniform light texture with fine brush parallel to line of curb, to match approved sample.
      d. Sand Finish: Washed and finish shall be achieved by rubbing with bristle brush and flooding surface so that concrete fines are exposed slightly and resultant surface is similar to medium grit sandpaper.
      e. Washed Exposed Aggregate Finish:
         1) Place concrete using specified aggregate/concrete mix, screed tamp and bull float to desired elevation. A compatible water-reducing retarding admixture may be added in warm weather if desired. Apply surface retardant as soon as screeding and floating is complete.
         2) If concrete is pumped into forms, lightly top seed surface of concrete with additional 3/8" size aggregate as required to match approved sample.

3) Cover slab with acceptable curing cover to prevent drying out. If fog cure is employed, start no sooner than recommended by retardant manufacturer.
4) Check retarded surface at regular intervals to determine optimum time for removing retarded surface mortar.
5) Broom and wash aggregate surface to remove mortar to its optimum (approximately 1/8" to 1/16" at surface stone depth) to match sample.
6) After aggregate is exposed, proceed with proper curing.

f. Steel Trowel Finish: After surface water disappears and floated surfaces sufficiently hardened, steel trowel and retrowel to smooth surface. After concrete has set enough to ring trowel, retrowel to a smooth uniform finish free of trowel marks or other blemishes. Avoid excessive troweling that produces burnished areas.

3.11 DAMPPROOFING

A. Mop apply one heavy coat of asphalt dampproofing to soil side of retaining walls and planter walls from top of wall footing to a minus 2 inches below finished soil grade.

3.12 CURING

A. Cure non-colored exposed concrete in accordance with Caltrans Standard Specifications Section 90-7.

B. Cure colored exposed concrete using Curing Compound for Colored Concrete as specified herein.

C. When applying Curing Compound, apply after initial set of fresh concrete when bleed water has evaporated from surface using a “Hudson-type” airless sprayer in accordance with manufacturer’s specifications.

D. Only water or curing compounds which impart no permanent color or gloss shall be used for curing concrete.

3.13 CLEANUP: Per Section 01 74 00.

END OF SECTION

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SECTION 32 14 14
PERMEABLE PRECAST CONCRETE UNIT PAVER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Permeable interlocking concrete pavers.
2. Crushed stone bedding material.
3. Open-graded sub-base aggregate.
4. Open-graded base aggregate.
5. Bedding and joint/opening filler materials.
6. Edge restraints.
7. [Geotextiles].

1.2 RELATED SECTIONS

1. Section 31 20 00, EARTH MOVING
2. Section 32 13 2o, SITE CONCRETE
3. Section 33 41 00, STORM UTILITY DRAINAGE PIPING

1.3 REFERENCES

A. Geotechnical Study Report by RGH Consultants, dated June 9, 2015.

B. American Society for Testing and Materials (ASTM)
1. C 67, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
2. C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
3. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
4. C 140, Test Methods for Sampling and Testing Brick and Structural Clay Tile, Section 8 – Freezing and Thawing.
5. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
6. C 936, Standard Specification for Solid Interlocking Concrete Pavers.
7. C 979, Specification for Pigments for Integrally Colored Concrete.
8. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
9. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
10. D 1883, Test Method for California Bearing Ratio of Laboratory-Compacted Soils.
11. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density. C.

C. Interlocking Concrete Pavement Institute (ICPI)
1. Permeable Interlocking Concrete Pavement manual.

1.4 SUBMITTALS

A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Manufacturer's drawing and details: Indicate perimeter conditions, junction with other materials, expansion and control joints, paver [layout,] [patterns,] [color arrangement,] installation [and setting] details. Indicate layout, pattern, and relationship of Paving joints to fixtures and project formed details.

C. Minimum 3 lb (2 kg) samples of sub-base, base, and bedding, aggregate materials.

D. Sieve analysis of aggregates for sub-base, base, and bedding, materials per ASTM C136.

E. Soils report indicating density test reports, classification, and infiltration rate measured on-site under compacted conditions, and suitability for the intended project.

F. Erosion and sediment control plan.

G. [Storm water management (quality and quantity) calculations.]

H. Permeable concrete pavers:
   1. Manufacturer's product catalog sheets with specifications.
   2. [Four] representative full-size samples of each paver type, thickness, color, and finish. Submit samples indicating the range of color expected in the finished installation.
   3. Accepted samples become the standard of acceptance for the work of this Section.
   4. Laboratory test reports certifying compliance of the concrete pavers with ASTM C936.
   5. Manufacturer's material safety data sheets for the safe handling of the specified materials and products.

I. Paver Installation Subcontractor:
   1. A copy of Subcontractor's current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
   2. Job references from projects of a similar size, type, and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.
   3. Written Method Statement and Quality Control Plan that describes material staging and flow, paving direction and installation procedures, including representative reporting forms that ensure conformance to the project specifications.

1.5 QUALITY ASSURANCE

A. Paver Installation Subcontractor Qualifications:
   1. Utilize an installer having successfully completed concrete paver installation similar in design, material and extent indicated on this project.

2. Utilize an installer holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.

B. Review the paver installation subcontractor's Method Statement and Quality Control Plan with pre-construction meeting of representatives from the manufacturer, paver installation subcontractor, general contractor, engineer and/or owner's representative.

C. Mock-Ups:
1. Install a 10 ft x 10 ft (3 x 3 m) paver area.
2. Use this area to determine surcharge of the bedding layer, joint sizes, lines, laying pattern(s), color(s) and texture of the job.
3. This area will be used as the standard by which the work will be judged.
4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
5. If mock-up is not retained, remove and properly dispose of mock-up.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver bundle.
1. Coordinate delivery and Paving schedule to minimize interference with normal use of buildings adjacent to Paving.
2. Deliver concrete pavers to the site in plastic wrapped cubes capable of transfer by forklift or clamp lift.
3. Unload pavers at job site in such a manner that no damage occurs to the product or existing construction.

D. Storage and Protection: Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install in rain or snow.

B. Do not install frozen bedding materials.

1.8 MAINTENANCE

A. Extra materials: Provide **10%]** additional material for use by owner for maintenance and repair.

B. Pavers shall be from the same production run as installed materials.

PART 2 - PRODUCTS

Note: Some projects may include permeable and solid interlocking concrete pavements. Specify each product as required and require Mockup submittal of each type.

2.1 Manufacturers

A. Manufacturer: **Acker-Stone, or equal.**

B. Manufacturing:
1. Method of manufacturing paving stones to be single-layer production to insure dimensional uniformity, optimum color blending, and product strength and durability.

C. Permeable Interlocking Concrete Paver Units:
1. Paver Type: Aqua Via II 8.75 x 8.75 ADA compliant solid concrete (non-porous)
   a. Material Standard: Comply with ASTM C 936.
   b. Color: Oyster White, Granada White, Oyster Pewter.
   c. Finish: Grind Shot Blast
   d. Color Pigment Material Standard: Comply with ASTM C 979.

2.2 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

2.3 CRUSHED STONE FILLER, BEDDING, BASE AND SUBBASE

A. Crushed stone with 90% fractured faces, LA Abrasion < 40 per ASTM C 131, minimum CBR of 80% per ASTM D 1883.

B. Do not use rounded river gravel.

C. All stone materials shall be washed with less than 1% passing the No. 200 sieve.

D. Joint/opening filler, bedding, base and sub-base: conforming to ASTM D 448 gradation as shown in Tables 1, 2 and 3 below:
1. Table 1
   a. Bedding and Joint/Opening Filler Grading Requirements
   b. ASTM stone size No. 89
   c.

Sieve Size		Percent Passing
1)	12.5 mm (1/2 in.)	100%
2)	9.5 mm (3/8 in.)	90-100%
3)	4.75 mm (No.4)	10-55%
4)	2.36 mm (No.8)	50-30%
5)	1.16 mm (No. 16)	0-10%
6)	0.3 mm (No. 50)	0-5%

2. Table 2
   a. Base Grading Requirements
   b. ASTM stone size No. 57

c.

Sieve Size		Percent Passing
1)	37.5 mm (1 1/2 in.)	100%
2)	25 mm (1 in.)	95 to 100%
3)	12.5 mm (1/2 in.	25 to 60%
4)	4.75 mm (No. 4)	0 to 10%
5)	2.36 mm (No. 8)	0 to 5%

3. Table 3
   a. Sub-base Grading Requirement
   b. ASTM stone No.4
   c.

Sieve Size		Percent Passing
1)	75 mm (3 in.)	100%
2)	63 mm (2-1/2 in.)	100%
3)	50 mm (2 in.)	100%
4)	37.5 mm (1-1/2 in.)	90-100%
5)	25 mm (1 in.)	20-55%
6)	19 mm (3/4 in.)	0-15%
7)	12.5 mm (1/2 in.)	-
8)	9.5 mm (3/8 in.)	0-5%

E. Gradation criteria for the bedding and base:

1. D_{15} base stone $1D_{50}$ bedding stone < 5.
2. D_{50} base stone$1D_{50}$ bedding stone > 2.

2.4 ACCESSORIES

A. Provide accessory materials as follows:

1. Edge Restraints
   a. Material: Cast in place Concrete as show on Drawings.

2. Geotextile Fabric:
   a. Material Type and Description: Mirafi 140N Non-Woven.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Site Verification of Conditions:
   1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
      a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
      b. Provide written density test results for soil subgrade to the Owner, General Contractor and paver installation subcontractor.
      c. Verify location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage pipes and inlets.

2. Do not proceed with installation of bedding and interlocking concrete pavers until subgrade soil conditions are corrected by the General Contractor or designated subcontractor.

3.2 PREPARATION

A. Subgrade preparation and compaction to be performed as required by geotechnical engineer and per recommendations outlined in geotechnical report.

B. Verify that the soil subgrade is free from standing water.

C. Stockpile joint opening filler, base and sub-base materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

D. Edge Restraint Preparation
1. Install edge restraints per the drawings [at the indicated elevations].

3.3 INSTALLATION

A. General
1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the [geotextile] and sub-base materials.
2. Keep area where pavement is to be constructed free from sediment during entire job. [Geotextiles] Base and bedding materials contaminated with sediment shall be removed and replaced with clean materials.
3. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.

B. Geotextiles
1. Place on [bottom and] sides of soil subgrade. Secure in place to prevent wrinkling from vehicle tires and tracks.
2. Overlap a minimum of [12 in.] in the direction of drainage.

C. Open-graded sub-base and base
1. Moisten, spread and compact the No. 2 sub-base in 4 to 6 in. (100 to 150 mm) lifts [without wrinkling or folding the geotextile. Place sub-base to protect geotextile from wrinkling under equipment tires and tracks.]
2. For each lift, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (10 T) vibratory roller until there is not visible movement of the No. 2 stone. Do not crush aggregate with the roller.
3. The surface tolerance of the compacted sub-base shall be ±2 1/2 in. (± 65mm) over a 10 ft (3 mm) straightedge
4. Moisten, spread and compact No. 57 base in 100 mm (4 in.) lift oyer the compacted sub-base with a minimum 10 t (10 T) vibratory roller until there is no visible movement of the No. 57 stone. Do not crush aggregate with the roller.
5. The surface tolerance the compacted No. 57 base should not deviate more

than. ±1 in. (25 mm) over a 10 ft (3 m) straightedge.

D. Bedding layer
   1. Moisten, spread and screed the No. 89 stone bedding material.
   2. Fill voids left by removed screed rails with No. 89 stone.
   3. The surface tolerance of the screeded bedding layer shall be ±3/8 in (10 mm) over a 10 ft (3 m) straightedge.
   4. Do not subject screeded bedding material to any pedestrian or vehicular traffic before Paving unit installation begins.

E. Permeable interlocking concrete pavers and joint opening fill material
   1. Lay the pavers [Paving slabs] in the pattern(s) and joint widths shown on the drawings. Maintain straight pattern lines.
   2. Fill gaps at the edges of the paved area with cut units. Cut pavers subject to tire traffic shall be no smaller than 1/3 of a whole unit.
   3. Cut pavers and place along the edges with a [double-bladed splitter or] masonry saw.
   4. Fill the openings and joints with No. 89 stone.
   5. Remove excess aggregate on the surface by sweeping pavers clean.
   6. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 4,000 lbs (18 kN) centrifugal compaction force. This will require at least two passes with the plate compactor.
   7. Do not compact within 6 ft (2 m) of the unrestrained edges of the Paving units.
   8. Apply additional aggregate to the openings and joints, filling them completely. Remove excess aggregate by sweeping then compact the pavers. This will require at least two passes with the plate compactor.
   9. All pavers within 6 ft (2 m) of the laying face must be left fully compacted at the completion of each day.
   10. The final surface tolerance of compacted pavers shall not deviate more than ±3i8 (10 mm) under a 10 ft (3 m) long straightedge.
   11. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

3.4 FIELD QUALITY CONTROL

A. After sweeping the surface clean, check final elevations for conformance to the drawings.

B. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

C. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

3.5 PROTECTION

A. After work in this section is complete, the General Contractor shall be responsible for protecting work from sediment deposition and damage due to subsequent construction activity on the site.

END OF SECTION

SECTION 32 15 12
STABILIZED AGGREGATE SURFACING

FOR MORE INFORMATION: Contact GraniteCrete Incorporated, www.granitecrete.com or call (800) 670-0849.

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section Includes: Crushed aggregate blended with GraniteCrete admixture surfacing.
B. Related Work:
1. Section 31 20 00, EARTH MOVING
2. Section 32 13 2o, SITE CONCRETE

1.2 REFERENCES

A. Geotechnical Study Report by RGH Consultants, dated June 9, 2015.

B. ASTM C136-Sieve Analysis of Fine and Coarse Aggregates.

C. ASTM D2419- Sand Equivalent Value of Soils and Fine Aggregates.

D. “Greenbook” Standard Specifications for Public Works Construction.

E. RIS-Redwood Inspection Services Grades of California Redwood.

1.3 SEQUENCING

A. Do not install work specified in this Section prior to acceptance of earth moving. Coordinate work specified in this Section with work specified in other Sections to minimize cutting of and operation of heavy equipment over newly installed surfacing.

1.4 SUBMITTALS

A. Submit the following for approval:
1. Installer’s certification by product manufacturer.
2. Manufacturer’s product data sheet and installation instructions indicating that product complies with specifications for:
a. Crushed aggregate blended with GraniteCrete admixture surfacing.
b. Edging
3. Submit 1 quart sample of crushed aggregate with admixture in color specified.
4. Edging

1.5 QUALITY ASSURANCE / FIELD QUALITY CONTROL

A. Installer qualifications:
1. Installer Certified by GraniteCrete.
2. Installer to provide evidence to indicate successful installations of 25,000 square feet or more with an additional 6,000 square feet per year in providing

decomposed granite surfacing containing GraniteCrete admixture and / or ability to follow installation instructions.

B. GraniteCrete Certified Installers:
   1. McGuire and Hester,Matthew Dale-Landscape Group Manager, (510)632-7676.
   2. Ghilotti Bros., Migue Rangel, (415)760-0023.
   3. Juan Ontiveros, (831)200-5544.

C. Materials shall comply with manufactures specifications.

D. If product is installed by other than a GraniteCrete Certified Installer, contractor shall coordinate to ensure GraniteCrete personnel are onsite to oversee the installation process. Warranty is void otherwise.

1.6 MOCKUP

A. Prepare 4' x 4' minimum of crushed aggregate blended with GraniteCrete admixture surfacing, including base course and edging, at location approved by Owners Representative. Build mockup 21 days prior to installation. Intent of the mockup is to demonstrate surface finish, texture, color and standard of workmanship

B. Notify Owners Representative 7 days in advance of mockup construction.

C. Allow Owners Representative to view and obtain approval of mock-up before proceeding with rest of crushed aggregate blended with GraniteCrete admixture surfacing.

D. Approved mock-up may remain as first in place construction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver all GraniteCrete Admixture [bags] [bulk] materials in original, unopened packaging. Protect materials / aggregate from contamination with foreign matter. Store under waterproof cover and protect from dampness.

1.8 FIELD CONDITIONS

A. Do not install crushed aggregate blended with GraniteCrete admixture surfacing when sub-base is wet at saturated field capacity.

B. Do not install GraniteCrete materials during rainy conditions or below 40 degrees Fahrenheit.

PART 2 - MATERIALS

2.1 CRUSHED AGGREGATE BLENDED WITH GRANITECRETE ADMIXTURE SURFACING MATERIALS.

A. Acceptance Manufacturer:
   1. Specification is based on products by GraniteCrete, Inc., P.O. Box 1574 Carmel Ca. 93921; phone (800) 670-0849, fax (800) 670-0849, www.granitecrete.com.

GraniteCrete admixture is an all-natural product and does not contain oils, polymers, resins, or enzymes.

2. Substitutions: Products by other manufacturers that comply with specifications will be considered. Bidders to provide bid based on specified material only. Substitutions to be considered after bid awarded.

B. Decomposed Granite (DG), crushed aggregate.

1. DG shall have a 3/8" maximum gradation, produced from naturally friable rock /granite with enough fines to produce a smooth walking surface. Materials should be free from clay lumps, organic matter and deleterious material. Blends of coarse sand and rock dust are not acceptable.
2. Use a single supply source for the entire quantity required.
3. Gradation, in accordance with ASTM C136:

Seive Siezes	% Passing
3/8"	100
#4	85-100%
#8	70-80%
#16	50-65%
#30	40-50%
#50	25-35%
#100	15-25%
#200	10-15%

4. Color: Natural. To be selected by Architect from manufacturer's standard colors.
5. Supplier: Enz Vineyard Rock Quarry, Hollister CA.; phone 831.638.3807,or equal.

2.2 BASE COURSE MATERIAL

A. Class II Permeable Base Rock.

2.3 ACCESSORIES

A. Water: Free from contaminants that would discolor or be deleterious to crushed aggregate blended with GraniteCrete admixture surfacing.

B. Steel Edging:

1. Dimensions: [3/8"-thick x 4-inch], with overlapping joints.
2. Stakes: 3/16" x1-3/4" wide at top tapering to point at bottom; located 36" o.c. maximum.
3. Finish: Hot dipped galvanized.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine grading and subsoil conditions. Do not proceed until conditions are acceptable.

3.2 PREPARATION

A. **Subgrade preparation and compaction to be performed as required by geotechnical engineer and per recommendations outlined in geotechnical report.**

B. Excavate to depth required so edges of crushed aggregate blended with GraniteCrete admixture surfacing will match adjacent grades and have a maximum cross slope of 1 percent. [Remove excavated soil from site.]

C. Sub-grade Preparation: Comply with Greenbook Section 301-1 – “Sub-grade Preparation.” and per recommendations outlined in Geotechnical report.

D. Base Course Installation: Class II permeable base rock at 90% compaction.

E. [Edging]: Install flush with crushed aggregate blended with GraniteCrete admixture. Provide sufficient stakes to secure in place.]

3.3 INSTALLATION

A. Prior to installation, dampen surface on which installation is to occur. Install GraniteCrete surfacing as per [specified] [manufacturer’s] depth. GraniteCrete must be mixed on site. The use of a portable fiberglass concrete mixer for smaller jobs and the use of a volumetric concrete truck (a virtual portable batching plant) for larger jobs are specified. **Do not allow GraniteCrete blended aggregate to dry during installation. Mist as necessary to maintain optimum moisture content prior to compaction.**

B. Grade and smooth to required elevation. Smooth out any final irregularities prior to substantial compaction. Smooth by using the straight edge of an asphalt rake or a medium bristle broom over entire paving surface.

C. Compact: After optimum moisture content is achieved for compaction, thus achieving an 88% to 92% compaction. Hand-tamp around benches, sign posts, corners, boulders, etc. Initially use a vibratory plate and/or a 36” smooth drum roller in static position. Compact with the vibratory plate vertically and then horizontally at half speed. Follow with final compaction using a heavy lawn roller to obtain the final desired dense, smooth, uniform finish.

D. Take care compacting adjacent to planting and irrigation systems.

E. Minimum Compacted Thickness: Install to depth shown on Drawings.

F. Saw cut/trowel/install expansion joints every 5’in narrower paths, every 12’ in wider paths, and at every engineered stress areas.

G. Cover finished surface, when practical, to achieve maximum curing period. See Section 3.5.

H. Minimum Compacted Thickness (See Section Details):
   1. [Residential / Pedestrian Paths] [ ]: [3] inches.
   2. [Commercial / Light Vehicular Drives] [ ]: [4] inches.

I. Surface shall follow overall contours of landscape. Flat areas shall be [sloped] [crowned] for drainage. Slope [2.0%] [ ] percent minimum to drain away from structures.

J. Completed, finished surface shall be of consistent quality and free of deleterious materials such as organic materials, nails, stones, and loose material. Surface shall not have depressions or humps greater than [1/4] [ ] inch in ten feet.

K. **Cold Joints:** "Between pours", **stop at an area that makes them look intentional.** Snap line just back from loose GraniteCrete into compacted area. With a square nose shovel cut a straight line and then continue with installation. Place newly mixed GraniteCrete into area, **being careful not to overlap existing compacted material**. With a concrete trowel or similar tool, tamp new material at a 45 degree angle 1" above existing grade and compact. If necessary, "feather" in with a medium bristled broom. At end of day's installation, place a 2"X4" or 2"X6" piece of wood and compact. The following day carefully lift the wood and continue, compact and feather.

3.4 CURING PERIOD / PROTECTION

A. Do not allow traffic on crushed aggregate blended with GraniteCrete admixture surfacing for 5 days after placement or until compacted crushed aggregate blended with GraniteCrete admixture surfacing has fully cured. [Cover for extended curing period].

B. Protect crushed aggregate blended with GraniteCrete admixture surfacing from damage until project completion. [Repair damaged areas to match specified requirements].

3.5 MAINTENANCE & REPAIRS

A. Maintenance: Depending on the end users desired finish surface, maintenance may require occasional blowing off or brooming of paved surface. Depending on quality of compaction at time of installation, a thin veneer of loose aggregate material is typical after the full 28 days cure period. If cracking appears in a GraniteCrete surface broom loose aggregate "fines" into cracks and compact with a rubber mallet.

B. Repair: When repairing GraniteCrete it is important to use the original aggregate/decomposed granite and the original GraniteCrete Admixture color to match previously installed materials. If the paved surface has large areas of raveled material (loose aggregate/decomposed granite) the initial installation may not have been properly compacted or blended materials did not have proper compaction or optimum moisture content during installation. **GraniteCrete cannot be allowed to dry prior to final compaction.** The following are suggestions for repair of raveled materials:
   1. For the large loose areas, a minimum of a 3 inch of GraniteCrete can be installed. The repair areas need to be saw-cut at agreed length, removed, and re-installed. A portable concrete mixer or wheelbarrow can be used. Batch proportions are 33 shovelfuls of aggregate/decomposed granite to 3 shovelfuls of GraniteCrete Admixture (11 to 1 ratio). The mixture must be **thoroughly** dry mixed and moistened to specifications.
   2. In areas that collapse/fail due to equipment weight, reform and re-install with original materials as per specifications.

3. Cracks: repair by brooming existing surface fines into the cracks of filling with dry, pre-mixed materials, or both. The onsite aggregate/decomposed granite should be sieved to 1/8” minus material for better application and in-fill of cracks. Materials should be mixed as per ratio described above. Broom or fill the crack, moisten, compact (with rubber mallet or hand compaction plate) and “feather” material into the final finish.

Please refer to the GraniteCrete Installation Instructions for additional installation details.

END OF SECTION

SECTION 32 17 26
TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide Tactile Warning Surface Tiles (Truncated Dome Warning Surfaces) as shown and specified.

B. Related requirements specified elsewhere include:
   1. Section 32 13 12, SITE CONCRETE

1.2 QUALITY ASSURANCE

A. Reference Standards
   1. Americans with Disabilities Act (ADA), Federal ADA/State of California Title 24 Standards.
   2. The American Concrete Institute (ACI): "Manual of Concrete Practice," Parts 1, 2 and 3.
   3. ASTM Standards
   4. Manufacturer's specifications and recommendations.
   5. Perform work in accordance with all applicable laws, codes and regulations required by City of Sausalito.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s literature describing products, installation procedures and routine maintenance.

B. Sample for Verification Purposes: Submit samples, 6” by 6” of the kind and color proposed for use.

1.4 GUARANTEE: Detectable/Tactile Warning Surface Tiles work shall be guaranteed for a period of 5 years from date of final completion. The guarantee includes defective work, breakage, deformation, fading and loosening of tiles.

1.5 QUALITY ASSURANCE

A. Provide Detectable/Tactile Warning Surface Tiles and accessories as produced by a single manufacturer with a minimum of three (3) years experience in the manufacturing of Detectable/Tactile Warning Surface Tiles.

B. Installer’s Qualifications: Engage an experienced installer who has successfully completed installations similar in material, design, and extent to that indicated for this project.

C. 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).

D. 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 117A.4 and 1127B.5 for “Curb Ramps” and Section 1133B.8.5 for “Detectable Warnings at Hazardous Vehicular Areas”.

E. Vitrified Polymer Composite (VPC) 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.

F. Slip Resistance of Tile when tested by ASTM C 1028-96 the combined Wet and Dry Static Co-Efficient of Friction not to be less than 0.80 on top of domes and field area.

PART 2 - PRODUCTS

2.1 DETECTABLE WARNING TRUNCATED DOME SURFACE

A. Concrete Truncated Dome Paver shall be 12” x 12” X 2” integrally colored pavers from 5000 psi (34m450 kpA) hardrock concrete using Type lll cement, standard color # Charcoal 511 w Light Sandblast Finish by Stepstone, Gardena, CA 800/527-9029; or approved equal.

B. Concrete Truncated Dome Paver Grout: Consist of 1 to 1 ½ parts dry Portland Cement and color. Submit colored samples for approval. Consist of 1 part Portland Cement and 4 parts sand. Add up to 10% lime. When the grout core is 2" or more wide, substitute part of the sand with 1 to 2 parts of pea gravel to the above grout mix. Add water to grout to cause it to flow without segregation into all voids intended to be filled, and to produce a 28-day strength of 2000 psi. Plaster sand may be added to prevent segregation, provided strength is maintained. Color: Mortar to be colored a shade darker than stone as accepted by Owner’s Representative.

C. Color(s): Color shall be homogeneous throughout the tile. Color to be (Dark Grey conforming to Federal Color No. 36118)

PART 3 - EXECUTION

3.1 PREPARATION:

A. Subgrade preparation and compaction to be performed as required by geotechnical engineer and per recommendations outlined in geotechnical report.

B. Substrate shall be prepared as specified by manufacturer. Not recommended for asphalt applications.

3.2 INSTALLATION

A. Concrete Truncated Dome Paver shall be installed with struck grouted joints, color to match pavers, over 1” mortar bed over 6” thick reinforced (#4 rebar 12” o. c. max. both ways) concrete substrate.

3.3 CLEAN UP

A. Clean and protect as specified by the tile manufacturer.

END OF SECTION

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SECTION 32 32 53
STONE WALLS

PART 1 - GENERAL

1.1 SCOPE: Provide all labor, materials and equipment for subgrade preparation, subsurface drainage and installation of stone work indicated on the drawings and specified.

1.2 RELATED SECTIONS

A. Section 32 13 2o, SITE CONCRETE

1.3 REFERENCES AND STANDARDS

A. Reference to "Standard Specifications" shall mean the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.

B. Perform work in accordance with all applicable laws, codes and regulations required by **City of Sausalito.**

C. Concrete Reinforcing Steel Institute (CRSI): “Manual of Standard Practice” and “Recommended Practice for Placing Reinforcing Bars”.

D. California Code of Regulations, Title 24, 2007 Edition, also known as California Building Code (CBC).

1.4 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "project Management and Coordination."

B. Preconstruction Soil Testing: Engage a qualified independent testing agency to test soil reinforcement and backfill materials for compliance with design criteria.

C. Installer Qualifications: Firm specializing in design and installation of segmental retaining walls and :
1. With not less than 2 years documented experience.
2. With a minimum of five previously constructed successful projects, similar in size and magnitude, using specified retaining wall system; Provide contact names and numbers.
3. Site supervisor with verifiable qualified experience suitable for this project.

1.5 Testing and Inspection, per Section 01 45 00.

1.6 SUBMITTALS, per Section 01 33 00.

A. Mockups: Build 4' by 4' sample wall mockup over prepared, tested and approved subgrade to verify selections made under sample submittals and to demonstrate functional and aesthetic effects and set quality standards for materials and execution.

Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Do not start masonry work until mock-up has been approved by Owner's Representative.

PART 2 - MATERIALS

2.1 PORTLAND CEMENT: ASTM C150, Type I.

2.2 SAND: ASTM C144; natural sand containing not more than 2% of silt and clay by weight with specific gravity not less than 2.65.

2.3 LIME: ASTM C5, slake; screen through 16 mesh, then store and protect for 10 days.

2.4 STONE

A. Dimensional natural stone quarried into blocks of shapes and sizes suitable for the retaining wall configuration as designated. : "Sonoma" type field stone, sized as shown and generally rectangular in shape, naturally weathered with smooth moss and lichen covering top and sides. Stone shall generally have flat tops suitable for stacking.
   1. Face Stone and Color: Natural “Sonoma” type, Buff color.
   2. Texture: Split face, on long surfaces and sawn on short ends, top and bottom.
   3. Face Shape: Irregular or snapped face.
   4. Height: 8 to 10 inches minimum.
   5. Length 8 to 10 inches minimum
   6. Width (Depth from Face) 2 inches minimum
   7. Capstone (Depth from Face) 6” minimum
   8. Moisture Absorption: 3 percent, maximum
   9. Compressive Strength, Dry: 18,000 psi minimum.
   10. Dimensional Tolerances: Plus/minus 3/4 inch from specified dimension.
   11. Appearance: Natural quarried face without machine marks or scrapes.

B. Wall Caps: Dimensional stone units with abutting edges saw cut to provide tight fitting, flush end-to-end joints spanning full width of top of wall.
   1. Depth: to fully cover wall stone.
   2. Grout: To secure cap units as top course of wall.

C. Concrete Foundation: Reinforced concrete foundation with compressive strength of 3,000 psi minimum.

D. Drainage backfill: Class 2 permeable backfill per Caltrans with Subsurface Drain system as described herein.

2.5 MORTAR: Consist of 1 part Portland Cement and 4 parts dry, loose sand. Add not less than 1/4 nor more than 1/2 part lime putty or hydrated lime per volume of cement content. Insure mortar with 28-day strength of at least 1500 psi.

2.6 GROUT: Consist of 1 part Portland Cement and 3 parts sand. Add up to 10% lime. When the grout core is 2" or more wide, add 2 parts of pea gravel to the above grout mix. Add water to grout to cause it to flow without segregation into all voids intended to be filled, and to produce a 28-day strength of 2000 psi. Plaster sand may be added to

prevent segregation, provided strength is maintained. Color: added to mortar where indicated for use.

2.7 REINFORCING MATERIALS

A. New, free of rust, Billet steel bars: Current ASTM designation A615.

B. Bar Reinforcement: ASTM A615.
1. #3 and smaller: Grade 40.
2. #4 and larger: Grade 60.
3. Tie wire: #6 minimum, black and annealed.

C. Bar Reinforcement recycled content shall be a minimum of 75% recycled post consumer steel.

2.8 ANCILLARY MATERIALS

A. Dampproofing: Per CALTRANS Standard Specifications, Section 54.

B. Subsurface Drain behind Retaining-Type Walls: All walls that retain 30 inches of soil or more shall include a subsurface drainage system to relieve water pressure in accordance with Section 68 of the CALTRANS Standard Specifications and as shown. If no subsurface drain is shown, provide corrugated polyethylene plastic tubing per 68-1.02K surrounded with an envelope of Class 2 permeable material per 68-1.025, 3/4 inch maximum without fines, and wrapped with filter fabric per 68-1.028. Provide black colored rodent-proof slotted cap over exposed outfalls as accepted by Owner’s Representative. Locate outfalls to avoid drainage across walkways.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide testing and subgrade preparation complete.

B. Provide subgrade preparation and the base material installation complete, including clearing, grading, excavation, filling and dewatering. Take every precaution to obtain a subgrade of uniform bearing power compacted to a minimum of 95% relative compaction as determined by the ASTM D1557 laboratory test procedure and in Sections 19 and 20 of the Caltrans Standard Specifications.

C. Do any necessary finish grading and compaction in addition to that performed in accordance with earthwork to bring subgrades after final compaction to required grades and sections as indicated. Place no material on muddy subgrade. Remove un-compactable material and replace with clean fill and compact as required.

D. Excavate to lines and grades shown on Drawings. Do not disturb embankment or foundation beyond lines. Minimize over-excavation.

E. After excavation and prior to placement of leveling materials, Contractor's Geotechnical engineer shall examine bearing soil surface to verify strength meets or exceeds design

requirement and assumptions and issue report to Owner's Representative for acceptance. Replace any unsuitable bearing soil as directe by Geotechnical Engineer.

3.2 REINFORCEMENT

A. All concrete footings, walls, grade-beams 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 or as accepted by Owner's Representative.

3.3 INSTALLATION

A. Install in accordance with Drawings and applicable codes and regulations.
   1. Place first course of units on concrete foundation; check alignment and level. Check for full contact with base and for stability.
   2. Place units side by side for full length of wall, aligning back face of straight walls using string line or offset from base line.
   3. Do not leave gaps between units.
   4. Place succeeding courses by overlapping units below at joints. Insert metal pins between walls as indicated. Check for proper alignment and batter. Place succeeding courses.

B. Setting Stones:
   1. Distribute stones of various color. Select stones roughly squared and pitched to line and place evenly at all wall angles and at all wall ends. Lay flat and stratified rocks in approximate horizontal position, not on edge.
   2. Brush free of dust or other foreign matter and thoroughly wet before placing. Set in full mortar beds. **Allow joints to vary from 1/2" to 1".**
   3. Provide sufficient number of rocks to install complete wall from lines and grades shown on the drawings and details.

3.4 DAMPPROOFING

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

3.5 CLEANUP: Per Section 01 74 00

A. Exercise care that no mortar or grout comes in contact with exposed face of work. Clean immediately.

B. Use only stiff fiber brushed and wooden scrapers in keeping work clean as it progresses or in cleaning down at completion. Use no metal implements.

END OF SECTION

SECTION 12 93 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 1.1 DESCRIPTION

A. Furnish and install all site furnishings shown on drawings and specified in accordance with the manufacturer's instructions and as shown on the drawings and as specified.

B. Related requirement specifications elsewhere:
1. Section 32 13 20, SITE CONCRETE
2. Section 32 15 12 - STABILIZED AGGREGATE SURFACING
3. Section 32 14 14 - PERMEABLE UNIT PAVERS

1.2 REFERENCES

A. Perform work in accordance with all applicable laws, codes and regulations required by the City and the State of California.

B. Manufacturer’s Instructions:
1. Where required in the Specifications that materials, products, processes, equipment or the like to be installed or applied in accordance with manufacturer’s instructions, directions or specifications, or words to this effect, it shall be constructed to mean that said application or installation shall be in strict accordance with printed instructions furnished by the manufacturer of the material for use under conditions similar to those at the job site.
2. All site furnishings shall be anchored or otherwise secured to prevent movement, unless stated otherwise. Provide concrete footings, corrosion resistant clips, etc. as accepted by the Owner's Representative.

C. Reference Standards:
1. State of California, Business and Transportation Agency, Department of Transportation: “ Standard Specifications.”
2. Manufacturers’ specifications and recommendations.

1.3 COORDINATION

A. Coordinate items of other trades. Contractor shall be responsible for the proper installation of all accessories embedded in concrete and for the provision of connections, holes, openings, etc., necessary to the execution of the work of the trades.

1.4 SUBMITTALS: Section 01 33 00

A. Submit the following as a single submittal for approval:
1. product data sheets of all site furnishings shown in drawings.
2. shop drawings for all site furnishings

PART 2 - MATERIALS

A. As shown on drawings.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install manufactured items in accordance with the manufacturer's instruction and as shown in the drawings and as specified herein.

B. Perform all work in accordance with all applicable laws, codes and regulations required by State of California and the City of Sausalito.

C. Set all work true and square, plumb and level. Remove and replace any wood that splits during or after erection until acceptance. Keep nailing neatly lined up.

D. Fabricate wood in as long pieces as practical unless otherwise indicated. End joints shall occur at supports. Keep all work clean, accurately cut, closely fitted and set to the required lines and levels. Blunt exposed edges by sanding or with plane.

E. Place washer under the head and nut of bolts where same bear on wood, except head of carriage bolt. Drill bolt holes same diameter as bolt.

F. Size bolts to fit flush with nuts. Countersink nuts and bolts as detailed.

G. Hammers with scored faces shall not be used in nailing.

H. Supply all miscellaneous metal units and install as specified herein under the Sections entitled "Miscellaneous Metalwork" and "Galvanizing." Hot-dip galvanize all metal fastenings, angles, etc., after complete fabrication.

I. Galvanized metal that is cut, damaged or modified after fabrication shall be immediately painted with Zinc-rich paint to prevent rusting.

J. Touch up paint any damaged surfaces to match original finish as accepted by Owner's Representative.

K. Set site furniture, level. Provide spacers under furniture to level as specified herein and acceptable to Owner’s Representative

L. 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.

3.2 CLEANUP, per Section 01 74 00.

END OF SECTION

SECTION 32 84 00
IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section consists of furnishing, layout and installing an irrigation system complete, including certification of irrigation system installation as required by the State of California Model Water Ordinance described herein.

B. Related work specified elsewhere includes:
   1. Section 31 20 00, EARTHWORK
   2. Section 32 90 00, PLANTING
   3. Section 26 00 00, ELECTRICAL
   4. Section 33 14 16, SITE WATER UTILITY DISTRIBUTION PIPING

1.2 CALIFORNIA MODEL WATER EFFICIENT LANDSCAPE ORDINANCE REQUIREMENTS

A. Contractor shall be familiar with and follow the State of California Model Water Ordinance, California Code of Regulations, Title 23 Waters, Division 2, Department of Water Resources, Chapter 2.7. Also, the Contractor is responsible to follow all local water ordinances.

B. Pursuant to the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall submit a Certification of Installation to the Local Jurisdiction /water purveyor as described in the construction documents and these specifications. Certification shall at a minimum include the following documents:

PART 1. Project Information Sheet
PART 2. Certification of Installation according to the landscape documentation package.
PART 3. Irrigation Scheduling and Controller Programming
PART 4. Schedule of Landscape and Irrigation
PART 5. Landscape Irrigation Audit Report
PART 6. Soil Management/Analysis Report with verifying implementation, see Planting Specification for analysis requirements.

1.3 QUALITY ASSURANCE

A. 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.

B. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the 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. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.

C. References, Codes and Standards:
   1. State of California Model Water Efficient Landscape Ordinance
   2. California Environmental Quality Act (CEQA)
   3. Water Use Classification of Landscape Species (WUCOLS).
   4. American Society of Irrigation Consultants (ASIC) Design Guidelines.
   5. California Landscape Standards, California Landscape Contractors Association, (CLCA) Sacramento, California.
   6. CAL-OSHA, title 8, Subchapter 4-Construction Safety Orders and Subchapter 7-General Industry Safety Orders.
   7. California Electric Code.
   8. California Plumbing Code (UPC) published by the Association of Western Plumbing Officials.
   9. NFPA 24, Section 10.4, Depth of Cover.
   10. Underwriters Laboratories (UL): Electrical wiring, controls, motors and devices, UL listed and so labeled.
   11. American Society of Testing Materials (ASTM).

D. Furnish without extra charge any additional material and labor when required by the compliance with all above mentioned codes and regulations, though the work be not mentioned in these specifications or shown on the drawings.

E. Experience: Assign a full-time employee to the job as supervisor for the duration of the Contract with a certified landscape technician, irrigation certification through CLCA or minimum of four (4) years experience in landscape irrigation installation.

F. 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's Representative.

G. Explanation of Drawings:
   1. Due to the scale of the Drawings, it is not possible to indicate all piping offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affected all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities 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 Owner's Representative. Notify and coordinate irrigation Work with applicable contractors for location and installation of piping and sleeves through or under walls, pavement and structures. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary.

H. Trench Interference with Tree Root Systems:
   1. Prior to trenching, layout main and lateral line locations within Drip Line of trees and review locations with Owner's Representative. Relocate any lines that may

interfere with existing root systems to avoid or reduce damage to root systems as accepted by Owner's Representative.

2. Mechanical Trenching is not allowed within dripline of existing trees to be protected except as approved by Landscape Architect

I. Coordinate plant locations with emitter locations.
   1. Adjust plant locations in relation to the subsurface emitter s as required to ensure that the plant roots receive the proper amount of water in order for it to thrive.
   2. Coordinate planting and irrigation and provide hand watering of emitter irrigated and drip irrigated areas as required to maintain moist root zones until end of plant establishment period.

1.4 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. The Drawings show, if applicable, existing above and below grade structures and utilities that are known to the Owner. Locate known existing installations before proceeding with construction operations that may cause damage to such installations. Existing installations shall be kept in service where possible and damage to them shall be repaired with no adjustment of Contract Sum. Verify with Owner if As Built drawings are available.

B. If other structures or utilities are encountered, request Owner's Representative to provide direction on how to proceed with the Work. If a structure or utility is damaged, take appropriate action to ensure the safety of persons and property.

C. Verify location of existing irrigation systems to be removed and/or replaced. Maintain any existing systems as required by the Drawings and Specifications, including temporary retention of systems necessary to maintain existing on site and adjacent planting.

1.5 SUBMITTALS, in accordance with Section 01 33 00.

A. All materials and/or substitutions to be submitted in a single submittal for approval.

B. Materials List:
   1. Submit required copies of the cut sheets and a complete list of materials proposed for installation, along with any proposed substitutions clearly identified and obtain the Owner Representative'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.
   3. Submit to Local Water Purveyor with copy to the Owner Certification of Installation as required by the State of California Model Water Ordinance.

C. 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.

2. If the product is approved and, in the opinion of the Owner's Representative, the substituted product does not perform as well as the specified product, the Contractor shall replace it with the specified product at no additional cost to the Owner.

D. Operations and Maintenance Manuals:
   1. Prior to the final acceptance of the irrigation system, furnish three (3) individually bound Operation and Maintenance Manuals to the Owner's Representative for use by the Owner. The manuals shall contain complete enlarged drawings, diagrams and spare parts lists of all equipment installed showing manufacturer's name and address. In addition, each Service Manual shall contain the following:
      a. Index sheet indicating the Contractor's name, address and phone number.
      b. Copy of the Landscape Irrigation Audit
      c. Copy of the 12-month irrigation schedule and estimate of annual water consumption
      d. Copies of equipment warranties and certificates.
      e. List of equipment with names, addresses and telephone numbers of all local manufacturer representatives.
      f. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate and maintain all equipment.
      g. Parts list of all equipment such as controllers, valves, solenoids and heads.

E. 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/meter.
      b. Connection to electrical power.
      c. Gate valves.
      d. Routing of sprinkler pressure lines (a dimension at least every 100 feet and as required to identify all changes in direction and location).
      e. Remote control valves.
      f. Routing of control valves.
      g. Quick coupling valves.
      h. All sleeve locations.
      i. Routing of all control wiring.
      j. Include all invert elevations below 12".
   2. Deliver a reproducible record drawing to the 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.

F. Controller Plan:
   1. Provide one Irrigation Diagram plan in each controller housing. The plan shall show the area controlled by each valve in different colors and for orientation, any major permanent structure such as buildings and roads.
   2. Charts to be waterproof and hermetically sealed between two pieces of transparent 10 mil thick plastic and installed in each controller on the door as accepted by the Owner's Representative no later than the time of the coverage test of the irrigation system.

G. 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 sprinkler, valve or other equipment supplied on this project.
2. Two (2) keys for each type of equipment enclosure.
3. Two (2) keys for each type of automatic controller.
4. Two (2) keys for each type of valve (including square type key for valves larger than 2")
5. Two (2) quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.
6. All lock keys shall be keyed alike.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Furnish and deliver materials in manufacturer's packaging, bearing original legible labeling.

B. The Contractor is cautioned to exercise care in handling, loading, unloading, and storing PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of the pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented, cracked, or otherwise damaged shall be discarded and, if installed, shall be replaced with new piping.

1.7 SEQUENCING AND SCHEDULING

A. Acceptance: Do not install main line trenching prior to acceptance by Owner's Representative 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.
   2. Bubbler Heads: Install after placement of tree, but prior to backfill with planter soil mix.
   3. On-Structure Equipment: Install piping and risers after waterproofing is accepted.
   4. Sprinkler Head in Pots: Install riser and seal the penetration of the pot prior to backfill of pot with drainage materials and planter soil mix.
   5. Coordinate work schedule with Owner to avoid disruption of landscape maintenance of existing landscaping.
   6. Install piping prior to soil preparation (planting soil amendment installation).

1.8 WARRANTY, per Section 01 78 36.

A. In addition to manufacturer's guarantees and warranties, work shall be warranted for one (1) year 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 form in the Operation and Maintenance Manual.

1.9 OPERATION

A. Routine: Inspect and adjust all spray heads and control valves including raising or lowering of spray head heights to accommodate plant growth and weather conditions.

B. Controller: Inspect regularly for power interruption and reset clock as required. Adjust station timing to accommodate changes in plant growth and weather conditions.

C. 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.

D. Climate Change: Set and program automatic controllers in response to seasonal requirements and requirements of newly planted materials.

PART 2 - PRODUCTS

2.1 PIPE

A. Pressure Main Line Pipe and Fittings: All PVC fittings shall bear the manufacturer's trademark name, material designation, size, applicable I.P.S. schedule and NSF seal of approval.

B. All main line pipe shall be solvent welded and shall be schedule 40 unless shown otherwise on the Drawings.
   1. PVC Pressure Rated Pipe: ASTM D2241 NSF approved Type I, Grade I, solvent welded PVC with an appropriate standard dimension ratio (S.D.R.).
   2. PVC Scheduled Pipe: ASTM D1785 NSF approved, Type I,
   3. Grade I, solvent welded PVC.
   4. PVC Solvent-weld Fittings: ASTM D2466 Schedule 40, 1-2, II-I NSF approved.
   5. Solvent Cement and Primer for PVC solvent-weld pipe and fittings: Type and installation methods prescribed by the manufacturer.
   6. Connections between Main Lines and RCVs: Schedule 80 PVC (threaded both ends) nipples and fittings unless required otherwise by local jurisdiction.
   7. Valves 2-inch and larger shall be flanged only.
   8. Copper pipe shall be Type K or Red Brass where threaded joints are required and Type L otherwise.

C. All lateral line pipe shall be solvent welded and shall be schedule 40 unless shown otherwise on the Drawings.

2.2 CONDUITS & SLEEVES

A. Sleeving shall be Schedule 40 PVC pipe sleeves and a minimum of two times the aggregate diameter of all pipes contained within the sleeve. Provide vertical sweep for all electrical conduit on each side of hardscape and terminate ends at 12" minimum depth and 12" from hardscape surface.

2.3 BACKFLOW PREVENTION DEVICE

A. As required by Code and as shown on Drawings. Verify with Owner if Anti-freeze Jacket is required and provide as required.

B. Riser assemblies from main line burial depth to backflow preventers shall be Schedule 40 brass pipe.

C. All metallic pipe and fittings installed below grade shall be painted with two coats of Koppers #50 Bitumastic, or approved equal. Pipes may be wrapped with an approved asphaltic tape in lieu of the liquid-applied coating.

2.4 BACKFLOW PREVENTION DEVICE ENCLOSURE

A. “Smooth Touch” enclosure without sharp edges, by Strong Box, available from V.I.T., Escondido, CA (800) 729-1314 or equal. Coordinate size of enclosure with plumbing for minimum clearance and size. Enclosure to include concrete footing with hasp and staple to receive padlock. Padlock N.I.C.

2.5 CONTROLLER:

A. **Pedestal-mounted** irrigation controller, as shown on drawings, and with the following minimum requirements.

B. Shall be weather – based and be compatible with rain shut off sensor.

C. Shall be user-friendly. The controller must have a minimum 20-character readout display describing actions or options, or a full visible panel of buttons, dials, or switches that control all different functions separately.

D. Shall have the ability to start a programmed sequence of valves a minimum of 5 times a day per program.

E. Shall have ability to easily and quickly change watering schedules due to change in weather.

F. Provide portable hand-held remote device compatible with controller and capable of operating all control valves.

A. Provide rain shut off device as manufactured by Control System manufacturer capable of shutting off all control valves. Locate in a location exposed to rain and hardwire to controller.

2.6 CONTROLLER GROUND

A. Provide each pedestal controller with its own ground rod. Separate the ground rods by a minimum of eight feet. The ground rod shall be an eight foot long by 5/8" diameter U.L. approved copper clad rod or as recommended by controller manufacturer. Install no more than 6" of the ground rod above finish grade. Connect #8 gauge wire with a U.L. approved ground rod clamp to rod and back to ground screw at base of controller with appropriate connector. Make this wire as short as possible, avoiding any kinks or bending. Install within pedestal housing base unless otherwise noted.

B. Provide each irrigation controller with its own independent low voltage common ground wire.

2.7 CONTROLLER ENCLOSURES

Designer Note: Specify Enclosure

A. Type: Use one of the following (unless noted otherwise on the Drawings). Verify correct equipment to fit the specified equipment:
   1. Stainless steel, NEMA Type 3 rated, with back panel, padlocking hasp and padlock Rain Bird, Le Meur, "Strong Box" or approved equal. See Detail for pedestal construction.

2.8 MASTER CONTROL VALVE, NORMALLY OPEN

A. Master control valve shall be a 24 VAC, industrial type, solenoid control valve, Griswold 2000 series or equal. Valve shall be equipped with spring loaded packless diaphragm, cast iron body and bronze trim. The valve shall be of the normally open type and shall be equipped with four-prong (cross) flow control. Valve shall be slow closing without chatter settings or adjustment. Valve shall have a mechanical self-purging internal control system with tapered, serrated, scrubbing rod through diaphragm for positive, variable port opening and cleaning. No solenoid port screens. Valve solenoid shall be corrosion-proof, molded in epoxy to form one integral unit with no connection shunts and shall be 24 VAC, 3 watt maximum.

2.9 FLOW SENSORS

A. Compatible with controller and as recommended by controller manufacturer.

2.10 ISOLATION VALVE:

A. Valves 3 inches and smaller: 125 lb. WSP bronze gate valve with screw-in bonnet, non-rising stem and solid wedge disc, NIBCO T-113 K, or approved equal. Valves shall be line size.

B. Valves larger than 2”: shall have square nut stem and o-ring connections for key operation.

2.11 QUICK COUPLER VALVES:

A. Quick coupler valves shall be as listed on the Drawings with 10" diameter black box and black lid similar to isolation valve box described below.

2.12 BOX FOR ISOLATION & QVALVE & QUICK COUPLER VALVES

A. 10" diameter black plastic, Ametek, Brooks, Christy, Rain Bird with bolt down black lid marked "irrigation," or accepted equal. Avoid locating valve in paved areas. Provide H/20 Loading concrete box with bolt-down concrete lid if valve is located in paved area. Obtain location approval by Owner's Representative.

2.13 REMOTE CONTROL VALVE: As shown on Drawings and with the following minimum requirements:

A. Remote control valves shall be those normally manufactured for irrigation systems and shall have a slow, consistent speed of closure through entire closing operation, including last portion. To ensure this, the effective diaphragm working area/valve seating opening ratio must be a minimum 3 to 1.

B. Shall be mechanically self-cleaning to help prevent diaphragm or solenoid port plugging. To ensure this, the flush rod should be tapered to vary the size of the port opening as the diaphragm raises and lowers, thus allowing trapped material to escape. Rod is to be finished with a serrated surface to help scrub trapped material out. Screens not acceptable.

C. Shall have removable valve seat so valve can be repaired without removal from irrigation line.

D. Shall have ability to operate manually without the use of wrenches or special keys.

E. Shall have one-piece solenoid that attaches directly to valve without shunts or clips that can be lost.

F. Shall have cross top handle to adjust maximum travel of diaphragm to allow "tuning" of valve and closure.

2.14 BOX FOR REMOTE CONTROL VALVE

A. Rectangular black plastic valve box - Ametek, Carson, Christy, Rain Bird or accepted equal with non-hinged bolt down black colored lid marked “irrigation. Box body shall have knock outs. Do not saw cut body. The minimum size box is as shown on Drawings. Increase box size as required to fit. Valve box lids are to indicate the controller letter and station number of valve as accepted by Owner’s Representative. Also refer herein to required polyurethane tag at valve solenoid control wire under Control Wires. Locate the identification in center of the lid. Provide separate box for each valve. Provide H/20 Loading concrete boxes with bolt-down concrete lids for all valves that occur in paved areas.

2.15 CONTROL WIRES

A. Connections between automatic controllers and the solenoid-operated electric control valves shall be made with direct burial copper wire 14- AWG-UF 600 volt (minimum size). Pilot wires shall be a color other than white, and shall be a different color for each automatic controller with wires sharing a common trench. Common wires shall be white in color, with a different color stripe for each controller with wiring sharing the same common trench. No stripe is required if multiple controller wiring is not present.

B. Size of wire shall conform to the remote control valve manufacturer's specification for control wire sizes, but in no case shall the control wire be smaller than #14. Runs over 2,000 lineal feet shall be #12- AWG-UF 600 volt copper wire.

C. All wire splices are to be made within a valve box, with a copper crimp-type connector, and a "3-M" #DBY splice kit or Rain Bird “DBTWC25”.

D. Use continuous control wiring between controllers and remote control valves (no splices).

E. Provide polyurethane tag at valve solenoid control wire that shows the controller number and station number. Also refer to valve box lid identification.

F. Provide a spare control wire in each RCV box for future.

2.16 SPRAY HEADS

A. Pop-up as shown on drawings and with the following minimum requirements:.

B. Shall have approximately 30 psi water pressure coming out of nozzle to prevent "fogging" or misting. Shall have pressure-compensating devices.

C. Shall have ability to prevent low head drainage. Use heads with integral check valves.

D. Shall not have spray blocked by turf or shrubbery; use minimum 4" pop-ups in turf areas.

2.17 ROTOR HEADS

A. As shown on drawings and with the following minimum requirements:

B. Heads shall have exact matched precipitation rates. Radius and precipitation rates must be the same.

2.18 SWING JOINTS

A. Sprinklers and Bubblers: Use Dura, Lasco, Rain Bird or equal pre-assembled swing joints with O-rings.

2.19 Quick Coupling Valve: Dura 1-inch 1-A2-1-11-18 pre-assembled swing joint with O-rings and Dura quick lock to receive stabilizing rod.

2.20 SHRUB & TREE BUBBLERS

A. As shown on drawings

2.21 DRIP EMMITTER IRRIGATION

A. Drip Manifold:
   1. Pressure Regulator: Preset at 30 psi outlet pressure, ¾" female threaded inlet and outlet, by RainBird, Torro or equal.
   2. Emitters: Xeri-Bug (XB Series) by RainBird, Toro EZ Drip Series, or equal.
   3. Flexible PVC: ASTM D2287 algae-resistant flexible PVC as recommended by manufacturer of Drip Emitters.
   4. Drip tubing: Conform to A. S. A. E. standards for minimum inside diameter and wall thickness, Minimum 2% carbon black, Salco ¾" AR Drip PVC flexible drip hose, or equal.
   5. ¾" Y-filter, 200 mesh.
   6. Toro DL 2000 Air/Vacuum Relief Valves and In-line Spring Check Valves.
   7. ¾" manual PVC ball valve with extra 3' of hose coiled in valve box.
   8. Drip system in accordance with "RainBird Xerigation Low-Volume Landscape Irrigation Design Manual" and as shown on the drawings as required for a complete working system.

2.22 IN-LINE DRIP IRRIGATION

A. As specified herein and as shown on the drawings and in accordance with manufacturer's recommendations. Provide all miscellaneous valves, filters fittings etc. required for a complete, operable system including the following:

   1. Rain Bird XFD/XFS/XFCV with "Copper Shield" technology. Drip system in accordance with "RainBird Xerigation Low-Volume Landscape Irrigation Design Manual" and as shown on the drawings as required for a complete working system.
   2. Toro DL 2000 Techline, in-line Treflon impregnated emitter with Netafim Automatic Flush Valves, Toro DL 2000 Air/Vacuum Relief Valves in accordance with "Toro DL-2000 Low-Volume Irrigation Bidding Specifications and Design Details" and as shown on the drawings as required for a complete working system.
   3. Pop-up operation indicator
   4. Air/vacuum relief valves
   5. Flush valves

B. Drip Valve Assembly: Size valve box large enough and deep enough to contain assembly and allow convenient access and easy removal of filter screen. Position filter pointed down, approximately 45 degrees.

C. Pressure regulator: Size regulator in accordance with flow rate. Do not over size. Use factory pre-set regulator at 30 PSI.

2.23 Y-STRAINER

A. “Y”-Strainer upstream of remote control valves, Brass, 100 mesh.

2.24 RCV IDENTIFICATION TAGS:

A. Plastic or brass tags with valve number, approximately 2” by 2” with number imprinted, as accepted by Owner.

2.25 MISCELLANEOUS INSTALLATION MATERIALS

A. Solvent Cement and Primers for Solvent-weld Joints: Make and type approved by manufacturer(s) of pipe and fittings. Maintain cement proper consistency throughout use.

B. Pipe and Joint Compound: Permatex: Do not use on sprinkler inlet port.

2.26 MISCELLANEOUS EQUIPMENT/ACCESSORIES

A. Concrete for equipment pads (and thrust blocks if Bell-Type Pipe with O-Rings is required): Poured-in-place Class A concrete per Section 90 of the Caltrans Standard Specifications.

B. Sleeves and Conduits: See Drawings.

C. Key(s) for Quick-Coupling Valves:
1. Type: Same manufacturer as Quick-Coupling Valve.

2.26 OTHER EQUIPMENT: As shown on Drawings and required for a fully functional irrigation system.

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 Meter/Water Pressure: Test and verify that existing water pressure is the minimum pressure at maximum system g.p.m. to operate the irrigation system as indicated 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.

D. Notification: Submit written notification to Owner's Representative within ten (10) working days of above inspections describing all acceptable and non-acceptable site conditions.

3.2 CONNECTIONS TO SERVICES

A. Provide and coordinate connection to water meter.

B. Provide and coordinate connection of irrigation controller to electrical power source.

3.3 INSTALLATION

A. Install irrigation system components in accordance with this Section, with the Drawings, with the manufacturer's recommendations, and with established industry standards. The Contractor shall do nothing that may jeopardize any manufacturer warranty.

B. Automatic Controller:
   1. General: Install with lock box cutoff switch per local code and manufacturer's current printed specifications. Provide each controller with its own independent low voltage common ground wire.
   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.
   3. Labeling: Affix controller letter (i.e., "A") on inside of controller cabinet door with minimum of one-inch (1") high permanent letter.
   4. 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 legible 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.

C. Control Wiring:
   1. General: Install control wires in common trenches with sprinkler mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide looped slack at valves. Snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10 ft. intervals.
   2. Extra Length: Provide 30 inches (30") extra control wire at each remote control valve splice to facilitate the removal of the remote control bonnet to finish grade without cutting wires.
   3. Spare: Install one unconnected spare control wire running from the controller through each intermediate control valve box.
   4. Size: Minimum size of wire is to be determined strictly by the manufacturer's current printed specifications for remote control valves, but not smaller than #14.
   5. Detection Wire: Install a bare #12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search. Install the control wires on the bottom of the PVC supply line with electrical tape every ten feet (10').

6. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. In-line splices will be allowed only on runs exceeding 2500 feet and only in junction boxes.

A. Rain Shutoff Switch:
   1. Install switch in area not affected by irrigation or rain shadow. Provide wires in rigid conduit as accepted by Owner's Representative.

B. Excavating and Trenching:

   1. Prior to trenching, layout main and lateral line locations within Drip Line of trees and review locations with Owner's Representative. Relocate any lines that may interfere with existing root systems to avoid or reduce damage to root systems as accepted by Owner's Representative.
   2. Dig trenches wide enough to allow a minimum of three inches (3") between parallel pipe lines. Provide a minimum cover from finish grade as follows:
      a. 24-inches Deep: Over pipe on pressure side of irrigation control valve, control wires and quick-coupling valves.
      b. 36-inches Deep: Over all pipe and pipe sleeves under roadways, parking lots, entrance to parking lots and Fire-Access Lanes per NFPA 24, Section 10.4.4.
      c. 18-inches Deep: Over pipe on non-pressure side of irrigation control valve.
      d. Direct Burial PVC Piping Under Pavement: Provide a minimum of 4 inches of sand backfill on all sides and 24 inches cover to bottom of paving.
      e. On-Structure: Protect waterproofing with 2-inch layer of planting soil mix or as otherwise detailed.

C. Conduits and Sleeves:
   1. Coordination: Provide conduits and sleeves and coordinate installation with other trades.
   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.

D. Pipeline Assembly:
   1. Install pipe and fittings in accordance with manufacturer's current printed Specifications.
   2. Clean all pipes and fittings of dirt, scale and moisture before assembly.
   3. 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.
   4. Threaded Joints for Plastic Pipes:
      a. Use Permatex on all threaded PVC fittings except sprinkler heads and quick coupler valve ACME threads.
      b. Joining: Use strap-type friction wrench only. Do not use metal-jawed wrench. Assemble finger tight plus one or two turns.
   5. 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.

E. 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.

F. Detection Wire and Warning Tape:
a. Install a bare # 12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search.

G. Control Valves:
1. Install in valve boxes where shown on Drawings and group together where practical. Install box flush with finish grade, not necessarily level. If valve occurs in drainage swale, relocate out of drainage swale as approved by Owner's Representative.
2. Where two or more valves are installed adjacent to each other, provide at least six inches (6") separation. Align boxes in a row, perpendicular with pavement edge.
3. Permanently mark valve box lid with 2" black valve number and controller letter or with numbered metal tag inside box as approved by Owner's Representative.
4. Refer to control wiring for required spare wire in each valve box.

H. Install “Y”-Strainer upstream of remote control valves at backflow preventer with two pressure gauges, one upstream and one downstream of each strainer/filter.

I. RCV Identification Tags:
1. Install in remote control valve box as recommended by manufacturer and as accepted by Owner’s Representative.

J. Pop-up Spray Heads and Rotors:

1. Place all sprinkler heads in planting areas with top of heads set to finish grade or top of mulch as required.
2. Place part-circle pop-up sprinkler heads two inches (2") from edge of and flush with top of adjacent walks, header boards, curbs and mowing bands or paved areas and 12 inches (12") from building foundations at time of installation.
3. Set all sprinkler heads in turf to allow for settlement. Adjust as required after settlement. Hold heads two inches (2") clear of pavement edge.

K. Bubblers:
a. Coordinate installation with planting contractor to insure timely and proper placement of heads at new planting.

L. In-Line Drip Irrigation

1. Coordinate plant locations with emitter locations. Refer to QUALITY ASSURANCE herein.
2. Coordinate hand watering of emitter irrigated and drip irrigated areas. Refer to QUALITY ASSURANCE herein.
3. Coordinate emitter spacing with planting types and plant spacing as accepted by Landscape Architect. Install emitters at uniform **12 inches** on center maximum and 2 to 4 inches deep, except where emitter spacing and depth is shown otherwise.
4. Adjust spacing on slopes to prevent over watering at base of slopes. Install system in accordance with manufacturer's recommendations and as shown on the Drawings as required for a complete working system.
5. Provide air/vacuum relief valves at all high points on systems.
6. Provide filter as shown and as recommended by emitter manufacturer.
7. Tape pipe ends during installation and do not allow dirt or debris to enter pipe.
8. Use emitter line with the specified emitter flow rate and emitter spacing. Assemble dripper line to allow water to flow continuously and directly, with no dead ends or dead end loops between control valve and flush valve.
9. Use fittings at sharp bends and do not allow dripper line to kink.
10. Install emitter line around perimeter of planter not more than 3 inches off edge for ground cover and turf, 18 inches maximum for shrub planting.
11. Adjust alternate rows so emitters are spaced in a triangular pattern.
12. Collect water from multiple dripper lines and convey the water to automatic line flush valve.
13. Install flush valve at end(s) of collector laterals so that entire system will flush and be free of dirt and debris.
14. Flush valves shall be open when water is turned on for the first time and after a break in the main or lateral lines. Extend collector lateral as required and locate flush valve at convenient accessible location.
15. Flush the systems weekly through the first month of the maintenance period.
16. Thoroughly saturate soil prior to planting. Provide additional surface watering as required to keep plant root systems moist during planting establishment period.

M. Drip Emitter Irrigation:
1. Install system in accordance with "RainBird Landscape Irrigation Design and Specifications Xerigation Products and Details" or equal and as shown on the Drawings as required for a complete working system.
2. Install Toro DL 2000 Air/Vacuum Relief Valves at high points in system.
3. Install manual PVC ball valve with extra 3' of hose coiled in valve box at end(s) of collector laterals so that entire system will flush and be free of dirt and debris.
4. Install a continuous PVC irrigation mainline warning tape 12" above the supply line.

3.4 MISCELLANEOUS EQUIPMENT

A. Install miscellaneous equipment with concrete footings, brackets, etc., as required and as recommended by manufacturer.

3.5 FIELD QUALITY CONTROL

A. Testing of Irrigation System:

1. Make hydrostatic tests with risers capped when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure. Keep all couplings and fittings exposed.
2. Install two (2) pressure gauges at opposite ends of main line 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 Owner's Representative 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 detected during tests shall be repaired and test repeated until system passes tests at no additional cost to Owner.

B. Irrigation Audit Report with Certificate of Completion
1. Per the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall perform an irrigation audit and provide a report with certificate of completion to the local agency that may include, but is not limited to: inspection, system tune-up, system test with distribution uniformity, reporting overspray or run off that causes overland flow, and preparation of an irrigation schedule. Irrigation audits shall be conducted by a CLIA Certified landscape Irrigation Auditor by the Irrigation Association. Operation of the irrigation system outside the normal watering window is allowed for auditing and system maintenance.

C. Adjustment of the System:
1. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways and buildings. Adjust the arc and radius as applicable.
2. Include as a part of the work any nozzle changes or arc adjustments necessary due to daytime windy conditions during grass establishment period. After grass has been established and watering can be performed during calm early morning or evening hours, make any required adjustments to nozzles and arcs.
3. Set all sprinkler heads perpendicular to finished grades unless otherwise noted on the drawings.
4. When the landscape sprinkler system is completed and before planting, perform a coverage test in the presence of the Owner's Representative to determine if the water coverage for planting areas is adequate.
5. Test controllers individually in the presence of the Owner's Representative and the Landscape Architect. Demonstrate that all control valves operate electronically. Provide vehicles and radio equipment as necessary to expedite this process.
6. Demonstrate to Owner's Representative that irrigation scheduling programmed into controller is adequate for plant requirements without causing runoff, and that scheduling capacities of controller are utilized.

3.6 IRRIGATION SCHEDULING AND CONTROLLER PROGRAMMING

A. Per the requirements of the California Model Water Efficient Landscape Ordinance All irrigation schedules and programs shall be developed, managed and evaluated to utilize the minimum amount of water required to maintain plant health.

B. Irrigation controller Scheduling and Programming Parameters to be conducted by a CLCA Certified Irrigation manager and submitted to the local agency as part of the Certificate of Completion.

C. Parameters used to set the automatic controller shall be developed for each of the following:
   1. Plant establishment period
   2. Established landscape period
   3. Temporary irrigated area (if applicable)

D. Each irrigation schedule shall consider for each station all of the following that apply:
   1. Irrigation interval (days between irrigation)
   2. Irrigation run times (hours or minutes per irrigation event to avoid runoff
   3. Number of cycle starts required for each irrigation event to avoid runoff
   4. Amount of applied water scheduled to be applied on a monthly basis
   5. Application rate setting
   6. Root depth setting
   7. Plant type setting
   8. Soil type
   9. Slope factor setting
   10. Shade factor setting
   11. Irrigation uniformity or efficiency setting

E. 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 (CIMIS or soil moisture sensor data).

3.7 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 85% under planted areas.

C. Finishing: Dress off areas to finish grades. Re-dress any areas which subsequently settle.

D. Owner's testing agency will test backfill compaction in areas under paving.

3.8 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.

3.9 REVIEWS PRIOR TO ACCEPTANCE

A. Notify the Owner's Representative in advance for the following reviews, according to the time indicated:
   1. Supply line pressure test and control wire installation - 72 hours.
   2. Coverage and controller test - 72 hours.
   3. Final review - 7 days.

B. No reviews will commence without record drawings, without completing previously noted corrections, or without preparing the system for review.

3.10 FINAL REVIEW AND CLEANUP, per Section 01 77 00.

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's 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 earlier 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.

END OF SECTION

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SECTION 32 90 00
PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide planting work and planting maintenance complete as shown on the drawings and as specified including staking and layout of the landscaping, including soil sampling as required by the State of California Model Water Ordinance.

B. Related work specified elsewhere includes:

1. Section 31 10 00, SITE PREP & PLANT PROTECTION
2. Section 31 20 00, EARTH MOVING
3. Section 32 84 00, IRRIGATION

1.2 QUALITY ASSURANCE

A. Reference Standards:
1. All local, municipal and state laws, codes and regulations relating to all portions of this work are to be incorporated as part of these Specifications. These specifications shall not be construed to conflict with any of the above codes, regulations or requirements. The Specifications and Drawings shall take precedence when they call for materials, workmanship or construction of a better quality or higher standard than required by the above mentioned codes and regulations. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.
2. State of California Model Water Ordinance
3. Public utility agency having jurisdiction over the project work.
4. "Sunset Western Garden Book," Lane Publishing Co., Menlo Park, California; current edition.
5. "American Standards for Nursery Stock," American Association of Nurseryman, 230 Southern Building, Washington, D.C. 20005.
6. International Society of Arboriculture, Guide for Plant Appraisal, latest version.
7. US Composting Council Compost Analysis Program (CAP)
8. US Composting Council (USCC) Seal of Testing Assurance (STA) program.
9. Test Methods for the Evaluation of Composting and Compost (TMECC)
10. Manufacturer's recommendations.

B. Qualifications:
1. Experience: Assign a full-time employee to the job as foreman for the duration of the Contract who is 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 necessary to complete the tasks described herein in a competent, efficient manner acceptable to the Owner.

C. Requirement

1. Site Visit: At beginning of work, visit and walk the site with the Owner's Representative to clarify scope of work and understand existing project/site conditions.
2. 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.
3. 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.
4. Protect all existing and new plants from construction activities, deer & rodents: Contractor shall be responsible for protection of all planting per Part 3.

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. Soils & Amendment Testing
1. All soils & amendments to be tested for agricultural suitability by one of the following accredited soil testing laboratory (or approved equal). Components of the test shall include all major nutrients, pH, salinity, boron, sodium, micronutrients, copper, zinc, manganese and iron, adsorption rate, organic content and texture. The laboratory report shall include recommendations for adjusting fertilizer and amendment quantities.

Soil and Plant Laboratory, Inc.
352 Matthew Street (P.O. Box 153), Santa Clara, CA 95052; (408-727-0330)
Wallace Laboratories, LLC
365 Coral Circle, El Segundo, CA 02345, (310-615-0016)
Root Zone Associates
P.O. Box 18911, San Jose, CA 95118; (408-264-7024)

2. Upon approval of the laboratory's report by the Landscape Architect, the recommendations in the report shall become a part of the Specifications and the soil preparation procedures, quantities of soil amendment, fertilizer and other additives shall be adjusted to conform with the report at no additional cost to the owner. Note that there is a minimum quantity of organic amendment specified elsewhere in this specification section.
3. Significant issues with soil quality will require soil to be retested in the locations identified on Soil Analysis Plan, prior to proceeding with plant installation, to ensure that the recommendations in the report have been followed and the In-Situ Topsoil is agriculturally suitable as described in Part 2.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms. Subsoil is defined as either existing site soil located below the topsoil

prior to construction activities, or select fill used for rough grading during construction. Subsoil cannot be considered for use as planting soil.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally 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 larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

E. Planting Soil: Approved existing topsoil or imported planting soil, meeting the requirements herein. Subsoil cannot be considered for use as planting soil.

1.4 SUBMITTALS, per Section 01 33 00.

A. All materials and/or substitutions to be submitted in a single submittal for approval.

B. The following shall be submitted to the landscape architect for approval prior to the installation of landscape materials and products.

C. Manufacturer’s Technical data sheets for fertilizers, turf, and all other products and materials listed herein.

D. Manufacturer’s technical data sheets for amendments. Reports to be dated no more than 3 months prior to soil preparation.

E. 1-pint samples of imported soils, organic amendments/compost, mulches, and stones.

F. Submit planting soil and organic amendment laboratory reports a minimum of [3] weeks prior to beginning soil prep. See below for required soil analysis reports.

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G. Required Soil Analysis Reports. Reports to be dated no more than [3] months prior to soil preparation.

1. Soil Analysis Plan: Contractor to submit annotated plan showing confirmed locations of all required soil tests. Each location is to be identified with a unique label.
2. Existing Planting Soil Analysis: After approval of the Soil Analysis Plan, rough grading, and topsoil placement, contractor to obtain **[3]** representative samples of in situ topsoil taken from approved site locations at depth of 4" to 6" below finish grade and submit to an accredited soils testing laboratory for "agricultural suitability" analysis, including particle size, infiltration rate, and evaluation of physical and chemical properties of soil and recommendations for adding amendments and fertilizers to the soil.

3. Subsoil Analysis: In addition to the above required soil samples, contractor to obtain one representative sample of any subgrade soil that is to receive a layer of imported planting soil over it. The laboratory report shall include the soil's infiltration rate, total combined silt and clay content for determining the total allowable combined silt and clay content of the imported planting soil specified herein.
4. Imported Planting Soil Analysis: Contractor to submit an "agricultural suitability" analysis report from an accredited soils testing laboratory, including particle size, infiltration rate, and evaluation of physical and chemical properties of soil and recommendations for adding amendments and fertilizers to the soil. Soil to conform to requirements in Part 2.
5. Ammended Planting Soil Analysis: Significant issues with soil quality will require soil to be retested in the locations identified on Soil Analysis Plan, prior to proceeding with plant installation, to ensure that the recommendations in the report have been followed and the final Planting Soil is agriculturally suitable as described in Part 2.

H. The Contractor is responsible to follow all local water ordinances and make available to the local agency the soil analysis report and verification of its implementation as required.

I. Delivery Receipts upon request by Owner, provide delivery receipts for quantities of soil & amendments delivered to the site.

J. Plant sample of each variety of plant. Samples to be delivered to the site 2 weeks prior to plant installation and stored and maintained separately from entire quantity of delivered plants. Contractor to maintain plants throughout maintenance period. Plants to be reviewed in a single site visit.

K. Representative photos of each plant species. Photos to be of plants to be delivered to site and not a stock photograph.

L. Entire plant quantity delivered to the site. Plants to be reviewed prior to installation during a single site visit.

M. Representative photos of each tree species (unless trees previously tagged at nursery by landscape architect). Photos to be of trees to be delivered to site and not a stock photograph.

1.5 WARRANTY AND REPLACEMENT

A. Maintenance Period: See Part 3.

B. Warrant the work against weed growth for a period of four (4) months after application of Pre-Emergence Weed Killer.

C. Warrant all plants to be in a healthy, thriving condition until the end of the maintenance period, and deciduous trees, shrubs and vines beyond that time until active growth is evident.

D. Replace all dead and damaged plants and plants not in a vigorous condition immediately upon discovery and as directed by the Owner's Representative and at no

cost to the owner. Install replacement plants before the final acceptance of the maintenance period in the size specified.

E. Warrant all products, prepared soils and plant material installed and maintained by contractor against defects for a period of one year after final acceptance of the maintenance period.

PART 2 - PRODUCTS

2.1 SUBSOIL

A. **Submit soil analysis report** from an approved soi*l*s laboratory for approval by the Landscape Architect. Refer to Part 1 for soil testing requirements.

2.2 EXISTING PLANTING SOIL (ON-GRADE):

A. Existing Planting Soil is defined as on-site topsoil that is either to be removed and stockpiled for reuse or to remain in place during construction. Satisfactory planting soil shall be free of subsoil, clay, lumps, stones, and other objects over 4" in diameter, and without weeds, roots, and other objectionable material. The soil shall be fertile, friable, natural, productive soil containing a normal amount of humus, and shall be capable of sustaining healthy plant life. Soil shall not be infested with nematodes or with other noxious animal life or toxic substances. Soil shall be obtained from well-drained, arable land, and shall be of an even texture. Soil shall not be taken from areas on which are growing any noxious weeds such as Morning Glory, Equisetum, or Bermuda Grass, etc.

B. 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.

C. Amended Planting Soils are to conform with the following target levels. Elements are expressed as mg/kg dry soil or mg/l for saturation extract

pH value 6.5-7.9, lime none present salinity (ECe) 0.5-3 milli-mho/cm chloride <150 ppm nitrate 20-30 ppm SAR <3 phosphorus 8-20 mg/kg potassium 60-180 mg/kg	iron 4-15 mg/kg manganese 0.6-3.0 mg/kg zinc 1-3 mg/kg copper 0.2-3.0 mg/kg boron 0.2-0.5 mg/kg magnesium 25-100 mg/kg sodium <200 mg/kg sulfur 25-100 mg/kg

D. If sufficient on-site surface topsoil is not available, contractor to provide imported planting soil as specified below. Placement of dissimilar soils shall be coordinated with irrigation zones by the contractor to maintain separate valves for dissimilar soils.

E. **Submit soil analysis report** from an approved soils laboratory for approval by the Landscape Architect. Refer to Part 1 for soil testing requirements.

2.3 IMPORTED PLANTING SOIL (ON-GRADE):

A. Imported planting soil shall be screened and shall be free of subsoil, heavy or stiff clay, rocks, gravel, brush, roots, weeds, noxious seeds, sticks, trash, and other deleterious substances.

B. Imported Planting Soils are to conform with the following target levels. Elements are expressed as mg/kg dry soil or mg/l for saturation extract

pH value 6.5-7.9, lime none present salinity (ECe) 0.5-3 milli-mho/cm chloride <150 ppm nitrate 20-30 ppm SAR <3 phosphorus 8-20 mg/kg potassium 60-180 mg/kg	iron 4-15 mg/kg manganese 0.6-3.0 mg/kg zinc 1-3 mg/kg copper 0.2-3.0 mg/kg boron 0.2-0.5 mg/kg magnesium 25-100 mg/kg sodium <200 mg/kg sulfur 25-100 mg/kg

C. The silt and clay content of Imported Planting Soil shall not exceed that of the existing soil it is to be placed over. Except where otherwise required, it shall be a "Sandy Loam" as classified in accordance with USDA Standards with a combined total of between 25% to 40% Clay and Silt.

D. **Submit soil analysis report** from an approved soils laboratory for approval by the Landscape Architect. Refer to Part 1 for soil testing requirements.

E. Following approval of the sample, provide a one-half cubic yard sample, which shall be stored at the site of work for comparison with sample and subsequent loads of soil. The comparison sample shall be protected by a cover until the installation of all soil has been completed and accepted.

2.4 ORGANIC AMENDMENT FOR PLANTING SOILS (ON-GRADE):

A. Ground Redwood or Ground Fir Bark with the following properties:

Percent Passing	Sieve Designation	
100	9.51 mm	3/8"
50-60	6.35 mm	1/4"
20-40	4.76 mm	No. 4
0-20	2.38 mm	No. 8 8 mesh

Redwood Sawdust
Dry bulk density, lbs. per cu. yd., 260-280
Nitrogen stabilized - dry weight basis, min. 0.4%
Salinity (ECe): 4.0 maximum
Organic Content: 90% minimum
Reaction (pH): 4.0 minimum

Ground Fir and/or Pine Bark
Dry bulk density, lbs. per cu. yd., Min. 350
Nitrogen stabilized - dry weight basis, min. 0.5%
Salinity (ECe): 4.0 maximum

Organic Content: 90% minimum
Reaction (pH): 4.0 minimum

B. **Submit sample, product's technical data sheet, and analysis report** from an approved soils laboratory for approval by the Landscape Architect. The analysis report should include compliance to the specifications above and directions for product use.

C. Contractor may use Composted Yard Waste Amendment in lieu of the above specified Organic Amendment pending approval of product' technical data sheet.

2.5 COMPOSTED YARD WASTE AMENDMENT FOR PLANTING SOILS (ON-GRADE):
Courtesy of Soil & Plant Laboratory, Inc. Santa Clara, CA

A. The above ORGANIC AMENDMENT FOR PLANTING SOILS (ON-GRADE) is the specified organic amendment material. Acceptance of Composted Yard Waste Amendment in lieu of the above specified amendment material will be considered if the in situ planting soil salinity and soil structure is favorable for the inclusion of recycled yard waste organic matter, as approved by the Landscape Architect.

B. Composted yard waste amendment **will not** be accepted for use in on-structure raised planters and pots.

C. The composted yard waste amendment shall be a mixture of feedstock materials including green material consisting of chipped, shredded, or ground vegetation and mixed food waste, or clean processed recycled wood products. Single source, biosolids (sewage waste) compost will not be acceptable.

D. The addition of the compost shall result in a final ECe of the amended soil of less than 4.0 dS/m @ 25 degrees C. as determined in a saturation extract. Use the following table to determine the maximum allowable Ece (dS/m of saturation extract) of compost at desired use rate and allowable Ece increase.

DESIRED USE RATE		MAXIMUM ALLOWABLE Ece INCREASE FROM AMENDMENT		
Cu. Yds. Amendment Per 1000 Sq. Ft. for Incorporation to 6" depth	Volume percentage of amendment	1 dS/m	2 dS/m	3 dS/m
		Maximum ECe of Compost		
1	5	14	28	42
2	11	7	14	21
3	16	5	9.5	14
4	22	3.5	7	10.5
5	27	3	5.5	8.5
6	32	2.5	4.5	7

Example: Specification calls for 6 cu. Yrds. Compost per 1000 sq. ft. for incorporation to 6" depth, and site soil has an ECe of 2.0. In order to avoid exceeding ECe of 4 in final blend, compost ECe shall be less than 4.5 dS/m.

E. Composted Yard Waste Soil Amendment properties to conform to the following:

1. Gradation:

% Passing by weight		Sieve Designation
90		1/2"
85-100	9.51 mm	3/8"
50-80	2.38 mm	No. 8
0-40	500 micron	No. 35

2. Organic Content: Minimum 50% based on dry weight and determined by ash method. Minimum 250 lbs. organic matter per cubic yard of compost.
3. Carbon to nitrogen ratio: Maximum 35:1 if material is claimed to be nitrogen stabilized.
4. pH: 5.5 – 8.0 as determined in saturated paste.
5. Soluble Salts: See B. above.
6. Moisture Content: 35-60%.
7. Contaminants: The compost shall be free of contaminants such as glass, metal and visible plastic. Heavy meals, fecal colliform and Salmonella shall not exceed levels outlined as acceptable in the California integrated waste management regulations
8. Maturity: Physical characteristics suggestive of maturity include:
   a. Color: Dark brown to black.
   b. Acceptable Odor: None, soil-like, or musty.
   c. Unacceptable Odor: Sour, ammonia or putrid.
   d. Particle Characterization: Identifiable wood pieces are acceptable but the balance of the material shall be soil-like without recognizable grass or leaves.

F. **Submit sample, product's technical data sheet, and analysis report** from an approved soils laboratory for approval by the Landscape Architect. The analysis report should include compliance to the specifications above, directions for product use, and a list of ingredients. It is the Contractor's responsibility to secure test of the proposed composted yard waste amendment (2 quart sample) and submit to a Soils Laboratory for evaluation and recommendations. The composted yard waste amendment sample shall be a grab sample from the currently available material that has been tested within the last 30 days and shall include the composter's Compost Technical Data Sheet that includes lab analytical test results and directions for product use along with list of ingredients. Refer to Part 1 for soil testing requirements.

G. Based on the Soils Laboratory evaluation, the addition of composted yard waste amendment **shall not** be acceptable if it creates a leaching requirement.

2.6 PLANTS

A. Plant the variety, quantity and size indicated on drawings. The total quantities indicated on the drawings are considered approximate and furnished for convenience only. Contractor shall perform plant quantity calculations and provide all plants shown on the drawings.

B. 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.

C. 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.

D. Install healthy, shapely and well rooted plants with no evidence of having been root-bound, restricted or deformed.

E. Tag plants of the type or name indicated and in accordance with the standard practice recommended by the American Association of Nurserymen.

F. 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 of plant availability in writing to the Landscape Architect within 10 days after the effective date of Notice to Proceed.

G. Tree Form:
   1. Trees shall have a symmetrical form as typical for the species/cultivar and growth form.
   2. Central Leader for Single Trunk Trees: Trees shall have a single, relatively straight central leader and tapered trunk, free of co-dominant stems and vigorous, upright branches that compete with the central leader. Preferably, the central leader should not have been headed; however, in cases where the original leader has been remove, an upright branch at leas ½ the diameter of the original leader just below the pruning point shall be present.
   3. Potential Main Branches: Braches shall be evenly distributed radially around and appropriately spaced vertically along the trunk, forming a generally symmetrical crown typical for the species.
   4. Headed temporary branches should be distributed around and along the trunk as noted above and shall be no greater than 3/8” diameter, and no greater than ½ diameter of the trunk at point of attachment.

H. Tree Trunk
   1. Trunk diameter and taper shall be sufficient so that the tree will remain vertical without the support of a nursery stake.
   2. Trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.
   3. Tree trunk diameter at 6” above the soil surface shall be within the diameter range shown for each container size below, except where shown otherwise:

Container	Trunk Diameter	Soil level from Container Top
5 gallon	0.5” to 0.75”	1.25 to 2”
15 gallon	0.75” to 1.0”	1.75 to 2.75”
24” Box	1.5” to 2. 5”	2.25 to 3”
36” Box	>2.5”	2.25 to 3”
60” Box	>2.5”	3-6”

   4. Tree trunks shall be undamaged and uncut with all old abrasions and cuts completely callused over. Do not prune plants prior to delivery.

I. Tree Roots

1. Trunk root collar (root crown) and large roots shall be free of circling and/or kinked roots. Contractor may be required to remove soil near the root collar in order to verify that circling and/or kinked roots are not present.
2. The tree shall be well rooted in the container. When the trunk is lifted the trunk and root system shall move as one and the rootball shall remain intact.
3. The top-most roots or root collar shall be within 1" above or below the soil surface. The soil level in the container shall be within the limits shown in above table.
4. The rootball periphery shall be free of large circling and bottom-matted roots.
5. On grafted or budded trees, there shall be no suckers from the root stock.

2.7 TURF GRASS

A. Turf Sod**: NON NETTED**, Blend as follows:

SALT-TOLERANT TURFGRASS PARK MIX
20% Arena Perennial Ryegrass
% ColiseumPerennial Ryegrass
20% Fiesta 3Perennial Ryegrass
10% Midnight Kentucky Blue Grass
10 % SeaLink Slender Creeping Red Fescue
Seed Rate: 8 pounds/1,000 square feet

B. Sod Thatch
1. Machine cut sod to a uniform thickness of 3/4-inch excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends, in vigorous condition, dark green in color, free of disease, weeds and harmful insects. Broken pads, irregularly shaped pieces, and torn and uneven ends will be rejected.

2.8 HYDROSEED MIXES

A. Non-irrigated unless noted otherwise

B. Incorporate the following seed uniformly in hydromulch with tackifier at the specified rates per acre. Provide seed of the latest crop, labeled in accordance with the California Food Agricultural Code with the following ingredients per acre:

Hydroseed Mix:
65% Zorro Fescue (Festuca megalura)
30% Hykon Clover / Rose Clover (Trifolium hirtum)
5% Wildflower Mix
California Poppy (Eschscholzia californica)
Lupine (Lupinus succulentus)
Tidy Tips (Layia platyglossa)
Seed Rate: 60 lbs/acre
Wood Fiber: As specified below, minimum 1,800 lbs/acre
Fertilizer (16-20-0): 450 lbs/acre

Stabilizer: As provided with Hydroseed Mulch with Tackifier specified below, minimum 80 lbs/acre

As available from Pacific Coast Seed, Livermore, CA (925) 373-4417; Delta Growers Seed, Stockton, CA (209) 931-0684 and others.

C. Seeds of Legumes: Inoculated with pure culture of nitrogen-fixing bacteria prepared specifically for legume species in accordance with inoculant manufacturer's instructions.

D. All seed shall be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. In addition, the container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. Prior to seeding at the request of the owner, the contractor shall provide a letter of certification, original Association of Official Seed Analysts (AOSA) seed test results, and calculations of PLS content.

E. All legume seed shall be pellet-inoculated and provided in Bulletin AXT-280 of the University of California Cooperative Extension, "Pellet Inoculation of Legume Seed." Inoculant sources shall be species specific and shall be applied at a rate of 2 pounds of inoculant per one hundred pounds of seed.

2.9 HYDROSEED MULCH WITH TACKIFIER

A. Conwed Hydro Mulch 1000 or equal Buffalo Grove, IL, (800) 366-1180; and Hydrostraw or equal, Hydrostraw LLC, Rockford, WA, (800) 545-1755; fibrous, wood cellulose with tackifier containing no growth or germination inhibiting factors and manufactured in such a manner that after addition and agitation in slurry tanks with fertilizer, seed, water and other approved additives, the fibers in the material become uniformly suspended to form a homogeneous slurry; and that when hydraulically sprayed on the ground, the material forms a blotter-like ground cover impregnated uniformly with seed; and which, after application, allows the absorption of moisture and rainfall to percolate to the underlying soil. The fibrous mulch in its air-dry state shall contain not more than 15% by weight of water. The fiber shall have a temporary green dye and shall be accompanied by a certificate of compliance stating that the fiber conforms to these specifications.

B. The Tackifier/Stabilizer shall be an organic substance supplied in powder form and shall be psilium-based and packed in clearly marked bags stating the contents of each package. The California Department of Food and Agriculture shall certify the material as an Auxiliary Soil Chemical.

2.10 HUMATE FOR HYDROSEED

A. Shall be Organic Materials Review Institute (OMRI) listed and contain a least 40% Humic Acid. It shall be a natural granual humic acid based material that functions as an organic chelator and microbial stimulator. Humate shall not burn the plant material, is non-toxic and non-staining.

Humate Soil Conditioner

Humic Acids (from Leonardite)	40.00%
Organic Matter	40.00% – 50.00%
Carbon	50.00% – 60.00%
Nitrogen	0.05% - 1.00%
Phosophoric Acid	0.07%
Potash	0.13%
Sulfur	0.21%
Magnesium	0.18%
Calcium	0.32%
pH	4.0
Soluble Salts	1.8

2.11 FERTILIZERS

A. Gereral Landscape Fertilizers
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:
6% Nitrogen, 20% Phosphorus Acid and 20% Potash, (6-20-20)

Type B:
21 gram planting tablets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Agriform or 10gm BestPacks packets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Best Fertilizer Co.

Type C (Maintenance Fertilizer)
Complete fertilizer 21% Nitrogen, 7% Phosphoric Acid and 14% Potash (21-7-14).

If commercial fertilizer having the above analysis is not obtainable, other similar commercial fertilizer may be used providing it meets the approval of the Landscape Architect.

B. Sod Fertilizer
Provided by grower.

C. Sod Fertilizer:
Provided by grower.

D. Hydroseed Fertilizer
Hydroseed fertilizer to be used in the slurry shall be commercial fertilizers conforming to the requirements of the California Food and Agricultural Code, shall have a guaranteed analysis for nitrogen, phosphorus and potassium of 7-2-1. Products specified as slow release shall have been tested and demonstrate a nearly linear curve.

2.12 IRON SULFATE: Dry form.

2.13 EROSION CONTROL NETTING

A. New, with a uniform, open plain-weave, flame-retardant mesh. The mesh shall be [natural brown-tan] and made from unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Furnish jute mesh in rolled strips to meet the following requirements:
Width: 48 inches, with a tolerance of one-inch wider or narrower.
Not less than 78 warp ends per width.
Not less than 41 weft ends per yard.

2.14 PERFORATED DRAIN PIPE

A. Polyvinyl Chloride (PVC) pipe and pipe fittings shall meet extra strength minimum of SDR-35 of the requirements of ASTM Specification D3034.

B. Perforated and non-perforated corrugated polyethylene pipe, 3- to 10-inch diameter, shall meet the requirements of ASTM D883 and ASTM F412, and shall conform to Section 68 of the Standard Specifications.

C. Corrugated polyethylene pipe fittings shall comply with all requirements of AASHTO M-252-85I for 3- to 10-inch diameter pipe. Couplings shall be split or snap-on type for perforated pipe and split couplings with gaskets for non-perforated pipe. Cutting pipe with integral couplings will not be allowed.

D. Corrugated polyethylene pipe and fittings manufactured by Advanced Drainage Systems, Inc., shall be considered the standard to determine compliance to this specification.

E. Inspection Tube Cap: Paint cap one coat chocolate-brown color using Flat, exterior grade latex paint as accepted by Owner's Representative.

2.15 FILTER FABRIC / PERMEABLE LANDSCAPE FABRIC

A. Polyester or polypropylene non-woven filter fabric with uniform fiber distribution by "Terra Bond" #1115, "Mirafi, Inc." #140N, or approved equal.

2.16 PERMEABLE DRAIN ROCK

A. Permeable drain rock used in subsurface drain installations to be Class 2 permeable material in conformance with Section 68 "Subsurface Drains" of the Standard Specifications; gradation to 3/4" maximum size. Submit Sample for approval.

2.17 LANDSCAPE EDGING

A. Aluminum Edging, 3/16” X 4” by 8’ black anodized finish with 12” min long stakes set ½” below grade at each joint and maximum 4’ spacing, in-line joints without offset or double thickness, by Sure-Loc, Aluminum Pro, or approved equal.

2.18 PRE-EMERGENCE WEED KILLER

A. Clean non-staining as recommended by a licensed pest control specialist.

2.19 TREE STAKES

A. Lodge pole pine logs, clean, smooth, un-treated.

B. Unless otherwise shown on drawings, provide two-inch (2") diameter by eight feet (8') long for trees less than 8' high and 1" caliper.

C. Unless otherwise shown on drawings, provide three-inch (3") diameter by eight to ten feet (8' - 10') long for trees greater than 8' high and 1" caliper.

D. 2” O.D. Lodge pole tree stakes, painted black

E. 2” O.D schedule 40 Galvanized steel pipe

2.20 TREE TIES

A. Unless otherwise shown on drawings, provide rubber strap, 24-inch minimum length without sharp edges adjacent to trunk, V.I.T. cinch-tie, Dublin, CA, (818)882-9530, or approved equal.

B. Black corded rubber tree ties w/ clips by greensleeves.com

C. Biodegradable VStrap webbing by Treestrap.

2.21 TREE GUYING SYSTEM:

A. For trees up to 3" caliper, 3/16" galvanized steel cable, with rubber tree collar, 12" minimum long, and secured with cable clamp, and attached to anchor for below-grade location, Duckbill Model 40 DTS, or approved equal.

B. For trees 3" to 6" caliper, 3/16" galvanized steel cable with rubber tree collar, 18" minimum long, and secured with cable clamp, 3" take-up eye to eye turnbuckle, and attached to anchor for below-grade location, Duckbill Model 68 DTS, or approved equal.

C. Rootball guying system with three dead man anchors per tree as shown on drawings.

2.22 MULCH

A. Organic Mulch:
   1. Forest floor bark mulch by American Soil and Stone

B. Submit samples of rock mulch for approval by Landscape Architect until acceptable to Owner, at no extra cost.

2.23 STONES

A. Smooth 2”-8” tan river pebbles, Lin Creek or equal.

B. Stones to be installed around Drainage Structures to prevent mulch from migrating into stormdrain, and where shown in drawings

PART 3 - EXECUTION

3.1 PLANT PROTECTION AND REPLACEMENT

A. Inspect and protect all existing and new plants and trees against damage from construction activities, erosion, trespass, insects, rodents, deer, disease, etc. and provide proper safeguards, including trapping of rodent and applying protective sprays and fencing to discourage deer browsing. Maintain and keep all temporary barriers erected to prevent trespass.

B. Repair all damaged planted areas. Replace plants and re-seed or re-sod turf immediately upon discovery of damage or loss.

3.2 TOPSOIL STRIPPING AND STOCKPILING:

A. Strip existing planting soil to whatever depths encountered in areas that may be compacted due to construction activities and in a manner to prevent intermingling with the underlying subsoil or other objectionable material. Topsoil stripping is limited to area outside “Drip Line” of existing trees to remain and areas indicated on drawings and as approved by the Owner's Representative.

B. Remove heavy growths of grass from areas before stripping.

C. Stockpile existing planting soil 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.

D. 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.

3.3 LIME TREATED SOIL

A. If site work includes Lime Treatment of the subsoil, the Contractor shall remove full depth of treated soil beyond 12” from structure(s) and replace with approved planting soil.

B. Following removal of lime treated material, scarify subgrade to a minimum depth of 6 inches and test for drainage.

C. Test subgrade in all planting areas for drainage by flooding with minimum 4 inch depth of water puddle and verify complete absorption of standing water within two hours. If standing water is still present after two hours, provide perforated pipe and drain rock "French Drain" system in bottom of non-draining planters and connect to storm drainage system, as accepted by Owner's Representative prior to backfilling with approved planting soil.

3.4 GENERAL PREPARATION OF PLANTING SOIL

A. **Submit soil analysis report of amended soils** from an approved soils laboratory for approval by the Landscape Architect. Refer to Part 1 for soil testing requirements.

B. All planting soils to be amended as specified in soil laboratory analysis report(s).

C. Provide a minimum of [12”] depth of amended planting soil in allplanting areas, or more where shown or specified otherwise. Install soil in maximum [12”] lifts. Compact each lift prior to installing subsequent lifts.

D. Thoroughly wet down the planting areas to settle the soil and confirm irrigation coverage and operation. Allow soil to dry so as to be workable as described herein.

E. 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 inch and larger in size in turf areas and 2 inches or larger in shrub and ground cover areas. Secure approval of the grade by the Landscape Architect before any planting.

F. Prior to planting, soil shall be loose and friable to a minimum depth of [12”] with a relative maximum compaction of 85%. Rip and scarify any overly compacted and re-compacted planting areas (in two directions full depth of compacted soil) prior to planting.

G. Water settling, puddling, and jetting of soil and backfill materials as a compaction method is not acceptable.

H. Prior to planting, soil shall be moist, but not so moist that it sticks to a hand shovel. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.

I. Provide planting soil as a final lift in all planting areas within and adjacent to paved areas and other construction where native site soil has been covered by engineered fill and/or base rock. Unless otherwise shown or specified, finish grade in planting islands shall be crowned with a minimum 2% pitch to drain.

J. Finish Grade: Hold finish grade and/or mulch surface in planting areas1/2-inch below adjacent pavement surfaces, tops of curbs, manholes, etc. The subgrade of the mulch in mulched planting areas shall be a minus 2 inches at a distance of 12 to 18 inch from the edge of pavement. Drag finish grade to a smooth, even surface. Grade to form all swales and berms. Pitch grade with uniform slope to catch basins, streets, curb, etc., to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas that shall be uniformly sloped between finish elevations. Slope surface away from walls so water will not stand against walls or buildings. Control surface water to avoid damage to adjoining properties or to finished work on the site. Take required remedial measures to prevent erosion of freshly graded areas.

K. 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.

3.5 PREPARATION OF IN-SITU PLANTING SOIL

A. In-Situ Planting Soil is defined as top soil left in it's original place and undisturbed during construction activities which is to receive new planting

B. Except within tree driplines, rip all planting areas in two directions full depth to a minimum of **[12"]** into undisturbed native subsoil prior to amending. Scarification of any planting area which cannot be accomplished with a tractor shall be accomplished by an alternative method approved by the Owner's Representative to the specified depth to ensure proper percolation/drainage.

C. Inspect planting areas and remove all base rock and other foreign material. Verify placement of planting soil within dripline of trees with Owner's Representative.

A. Test depth of loose soil with hand shovel in presence of Owner's Representative in several locations as directed.

B. After acceptance of the planting condition, uniformly mix and amend soil with required fertilizers, nutrients, etc. per specifications herein and recommendations given in soils reports.

C. In the case of a contradiction between the quantity of organic amendment required by the soils laboratory analysis and the specified quantity below, the greater of the two quantities shall take precedence. Spread organic amendment, iron and Type A fertilizer evenly over installed and rough graded on-site topsoil in all planting areas including turf, ground cover and shrub areas at the following rates:
   a. Organic Amendment: 6 cubic yards per 1,000 square feet
   b. Fertilizer: Type A (6-20-20) at 20 lbs. per 1,000 square feet.
   c. Iron Sulfate: 10 lbs. per 1,000 square feet
2. Rototill above additives into soil [8-12"] inches deep. Keep iron sulfate off pavement and other surfaces to prevent rust staining. Correct all rust damage to work.
3. Final planting soil shall have a pH range of 6.5 to 7.5.

3.6 PREPARATION OF IMPORTED PLANTING SOIL (ON-GRADE)

A. Uniformly distribute and spread Subsoil or select fill in planting areas to achieve rough grading and compact to a maximum of 85% relative compaction.

B. Except within tree driplines, rip all planting areas in two directions full depth to a minimum of **[12"]** into undisturbed native subsoil 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 Owner's Representative to the specified depth to ensure proper percolation/drainage.

C. Thoroughly water-settle subsoil to required subgrade prior to installing Top Soil.

D. Prior to placing planting soil secure the Owner's Representatives acceptance of the planting areas subgrade condition. Test depth of loose soil with hand shovel in presence of Owner's Representative in several locations as directed.

E. After acceptance of the planting areas subgrade condition, uniformly distribute and spread planting soil backfill over scarified subgrade in planting areas as specified.

F. Mix and amend soil with required fertilizers, nutrients, etc. per specifications herein and recommendations given in soils reports.

3.7 WEED GERMINATION

A. Work shall be done under the supervision of a person licensed by the State of California as a pest control applicator and holding a qualified applicator license or a Qualified Applicator Certificate.

B. Following soil preparation and fine grading of planting areas, irrigate the planting areas to germinate any weed seeds for a minimum period of 21 days. Maintain the soil in a damp condition for a minimum depth of 4 inches. Following approval of the weed germination by the Owner's Representative, spray kill the weeds using a short lived systemic weed killer that will not affect subsequent planting. Confirm the weed kill and allow the soil to dry out to optimum degree for planting prior to planting.

3.8 PRE-EMERGENCE WEED KILLER

A. Work shall be done under the supervision of a person licensed by the State of California as a pest control applicator and holding a qualified applicator license or a Qualified Applicator Certificate.

B. Apply pre-emergence weed killer in all areas to receive ground cover planting. Obtain approval of the finish grades prior to applying weed killer and coordinate planting and watering with the pest control specialist prior to planting. Take care to keep weed killer off areas to be seeded.

3.9 EROSION CONTROL NETTING

A. Verify finished grades and provide Jute Mesh and single grind Redwood bark mulch on all slopes 3:1 and steeper as accepted by the Owner's Representative. Install jute mesh loosely up and down the slope in accordance with manufacturer's specifications and as follows. Fit the soil surface contour and hold in place with 12-inch long, 11-gauge (minimum) steel wire staples driven vertically into the soil at 18- to 24-inch spacing. Jute mesh strips shall overlap along all edges at least 6 inches. Ends of side strips shall be buried into the soil at least 6 inches. Drive staples along edges to securely anchor mesh to ground.

3.10 METAL EDGING:

A. Install as shown in drawings in continuous strips as indicated and in accordance with manufacturer's recommendations with stakes spaced 48 inches on center maximum and at all joints.

3.11 TREE AND SHRUB PLANTING

A. Mark tree and shrub locations on site using stakes, gypsum or similar approved means and secure location approval by the Landscape Architect before plant holes are dug. Adjust location as required prior to planting.

B. Review location of plants in relationship to irrigation heads and adjust location(s) that interfere with the function of the spray heads. Adjust locations as required to ensure that the plant roots receive the proper amount of water in order for the plants to thrive.

A. Square Tree Pits
   1. Drilled tree pits shall be modified to a square pattern with pit walls scarified to promote root penetration.

B. Excavate tree, shrub and vine pits as follows:

	Width	Depth
Boxed Trees	Box + 24"	Box depth
Canned Trees (15 gc)	Can + 18"	Can depth
Canned Shrubs/Vines (1- 5 gc)	Can + 12"	Can depth

C. Test drainage of plant beds and tree pits by filling with water (minimum 6"). The retention of water in planting beds and plant pits for more than two (2) hours shall be brought to the attention of the 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 tree pits to ensure root penetration and water test hole for drainage as required above.

E. Excavate plant hole or tree pit keeping excavated planting soil layer on the surface when backfilling around the plant. Carefully set plants as detailed without damaging the rootball. Superficially cut edge roots vertically on three sides. Remove bottom of plant boxes before planting. Remove sides of boxes after positioning the plant and partially backfilling.

F. Set plants in backfill with top of the rootball 1 inch above finished grade of adjacent soil. 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. Backfill native soil free of soil amendments under rootball and foot tamp to prevent settlement. Backfill remainder of the hole with soil mix and place plant tablets or packets (Type B fertilizer) 3 inches below finish grade and 1/2-inch from roots at the following rates:

1 gallon can plant	-	1 tablet or packet
5 gallon can plant	-	3 tablets or packet
15 gallon can plant	-	6 tablets or packet
24-inch box plant	-	6 tablets or packet
36-inch box plant	-	8 tablets or packet

H. Except for acid loving plants (Azaleas, Rhododendrons, Ferns, Camellias, etc.), use a soil mix of 2 parts soil from the hole, and 1 part amendment with iron added at the following rates:

1 gallon can plants	-	iron, 1/4 cup
5 gallon can plants	-	iron, 1/3 cup

15 gallon can plants - iron, 1/2 cup
24" box and larger - iron, 1 cup

For acid loving plants (Azaleas, Rhododendrons, Ferns, Camellias, etc.), mix 1 part soil from the hole and 1 part amendment to use a backfill around the plants.

Mix the iron, amendment and soil thoroughly for use in the top 8 inches of backfill around plants. For acid loving plants, mixture to be 1/2 soil from the hole and 1/2 amendment.

I. Remove any soil from top of plant rootballs and secure Landscape Architect's approval of rootball height prior to mulching.

J. After approval of rootball height, install mulch as required below.

K. Stake and/or guy trees as detailed. Drive stake(s) until solid (at least 12" beyond bottom of rootball) and remove excess stake protruding above top tree tie to prevent rubbing against branches. Avoid driving stakes through rootball. If subgrade does not accept stakes to a stable degree, delete stakes and guy the trees as specified herein and as detailed. Locate tree ties to avoid contact with tree branches. Locate top tie at tree flex point.

L. Build watering basin berms around trees and shrubs to drain through rootball. Basins are not required around trees in turf areas. Water backfill until saturated the full depth of the hole.

3.12 GROUND COVER PLANTING

A. Plant in neat, straight, parallel and staggered rows as indicated on plan. Plant first row one-half required ground cover spacing behind adjacent curbs, structures, or other plant bed limits. Plant ground cover to edge of water basins of adjacent trees and shrubs.

3.13 SODDED TURF

A. Install sod to patch and repair existing turf area due to re-grading or other construction activities.

B. 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.

C. 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.

D. When a conveniently large area has been sodded, water lightly to prevent drying. Continue to sod and to water until installation is complete.

E. After laying all sod, roll lightly to eliminate irregularities and to form good contact between sod and soil. Avoid a heavy roller and excessive initial watering.

F. 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.

G. Protect turf areas by erecting fences, barriers and signs necessary to prevent trespass. Keep barriers neat and well maintained.

3.14 HYDROSEED

A. Hydroseed preparation: Do all slurry preparation at the job site as per above for seeded turf planting.

B. Hydroseed Application:
1. General: All hydroseed applications are to be applied in a sweeping motion to form a uniform application and form a mat at the specified rates.
2. One-Step Hydroseed Application: For standard erosion control mixes on moderate (3:1 at 75 feet and flatter) slopes or for one year temporary cover, or for irrigated turf grass.

Lbs/Ac	Material
2,000	Conwed 1000, or equal
1,000	7-2-1 Slow release fertilizer
Varies	Seed as per mix specification
400	Humate
60	AM120 Mychorrizal Inoculant
100	Organic Stabilizer – M Binder or equal

3. Two-Step Hydroseed Application: For 2:1 slope up to 60 feet, non-irrigated and using native grasses and forbs or other slower developing plant materials:

Step one:

Lbs/Ac	Material
1,200	Conwed 1000, or equal
600	Hydrostraw, or equal
1000	7-2-1 Slow release fertilizer
Varies	Seed as per mix specification
400	Humate
60	AM120 Mychorrizal Inoculant
100	Organic Stabilizer – M Binder or equal

Step two:

1,200	Conwed 1000 , or equal
600	Hydrostraw, or equal
1000	Organic Stabilizer – M Binder or equal

4. Protection, handling of unused loads and reseeding as per seeded turf section above

3.15 MULCH:

A. Except where rock mulch is required, mulch all tree, shrub and ground cover areas with organic mulch to a 3-inch depth, except mulch to 2-inch depth where planting with ground cover plants from flats.

B. Hold bark mulch away from base (trunk) of plant 4" or as directed by the Landscape Architect.

C. Individual trees and/or shrubs planted in non-irrigated areas shall, at minimum, receive bark mulch over their watering basin and berm.

D. No mulch is required around trees in turf areas.

E. Install rock mulch to depth as detailed, minimum 2-inches for full coverage of soil surface, whichever is greater.

3.16 WATERING:

A. Water all trees, shrubs and ground cover 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. Provide supplemental hand watering of trees and shrubs, as required, to maintain a moist root zones throughout plant establishment period.

3.17 PRE-MAINTENANCE PERIOD REVIEW AND APPROVAL OF PLANTING

A. Maintain plants from time of delivery to site until final acceptance of landscape installation.

B. Receive approval of the installed planting prior to commencement of planting establishment maintenance period. Notify the Landscape Architect or Owner's Representative 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. Plumb all trees and tree and shrub supports.
   4. No partial approvals will be given.

3.18 PLANTING ESTABLISHMENT MAINTENANCE:

A. General Requirements:
   1. **Maintenance Period:** The planting establishment maintenance period required shall be **120 calendar days** after all planting and irrigation is complete, turf is installed/seeded, and as approved by Owner's representative. A longer period may be required if the turf is not thick, vigorous and even and has been mowed a minimum of 4 times, or if the plant material is not acceptably maintained during the maintenance period. The start of the maintenance period to be confirmed by Owner's representative. Contractor to notify landscape architect of start and end dates of 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 Owner Representative.
   2. Planting establishment maintenance immediately follows, coincides with, and is continuous with the planting operations, and continues through turf installation, 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, trespass, insects, rodents, disease, etc. 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 construction or maintenance activities.
5. Repair all damaged planted areas, and replace plants and resod turf 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 trees and shrubs 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 at all times.

B. Tree and Plant Maintenance:
1. Maintain during the entire establishment period by regular watering, cultivating, weeding, repair of stakes and ties, and spraying for insect pests. Prune when requested by the Landscape Architect.
2. Keep watering basins in good condition and weed-free at all times.
3. Replace all damaged, unhealthy or dead trees, shrubs, grasses, vines and ground covers with new stock immediately; size as indicated on the drawings.

C. Palm Tree Maintenance:
1. Do not over water palm trees. Do not use a predetermined watering schedule for the palms. Use a soil probe to determine optimum soil moisture level within the rootball.
2. Palm Tree Fertilizing: After palms show new frond growth, approximately 6 to 8 weeks after planting, apply specified balanced fertilizer with trace elements. Repeat application after 3 to 4 months. Established palms shall be fertilized spring and fall.
3. Check palms for plumb and re-plumb as required.
4. Check palms periodically for Penilcillium Rot and Fusarium Wilt. If the apical bud has fallen over (Penicillium Rot symptom) or Fusarium Wilt is suspected, remove the affected tree immediately.
5. Reapply broad-spectrum fungicide labeled for landscape use on soil borne diseases for Palms as noted herein under Palm Tree Planting.

D. Turf Maintenance:
1. Maintain during the entire establishment period. Cut as frequently as growth of grass requires. Cut to a height of two inches (2"), unless otherwise directed by the Landscape Architect.
2. Maintain constant moisture to a depth of eight inches (8").
3. Trim edges of turf at paving and headerboards at time of second cutting, and at each later cutting.
4. Keep a 2-foot diameter area at tree trunk free of turf at all times to serve as a mowing band. Do not create low area around base of tree.
5. Keep turf areas free of undesirable weeds and grasses by the application of suitable selective weed killers or hand pulling.
6. Re-seed **[Re-sod]** any turf areas damaged by construction activities as soon as evident.
7. Repair any gaps, hollow, settled or eroded areas by filling, rolling and re-sodding.

E. Fertilizing:

1. Upon approval and after submitting fertilizer delivery tags, maintenance fertilization shall begin 30 days after planting is complete. Fertilize all turf and ground cover areas by broad-casting Type C (21-7-14) fertilizer at the rate of 5 lbs. per 1,000 square feet evenly throughout. Reapply every forty-five (45) days until acceptable.
2. During the winter, for quick turf greening effect, calcium nitrate (15.5-0-0) may be applied at the rate of 6 lbs. per 1,000 square feet.
3. Early spring and fall substitute a complete fertilizer such as 15-15-15 applied at the rate of 6 lbs. per 1,000 square feet, to help insure continuing adequate phosphorus and potassium.
4. Apply ammonium sulfate fertilizer as necessary to maintain vigorous, green grass between fertilizations mentioned above.
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.

3.19 FINAL PLANTING REVIEW AND ACCEPTANCE

A. At the conclusion of the Maintenance Period, schedule a final review with the Owner, the Owner's maintenance person, and/or the Landscape Architect. On such date, all project improvements and all corrective work shall have been completed. If all project improvements and corrective work are not completed, continue the planting establishment maintenance period 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 restore all planted areas, mow and edge turf, plumb trees and tree supports, clear the site of all debris and present in a neat, orderly manner.

END OF SECTION

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SECTION 33 1416
SITE WATER UTILITY DISTRIBUTION SYSTEM

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 SUMMARY

A. Section includes
1. Domestic (potable) water supply piping and appurtenances.
2. Fire water supply piping and appurtenances.
3. Irrigation water supply (only).
4. Valves.
5. Backflow Prevention Assembly.
6. Fire Hydrants.
7. Restraint Systems.
8. Tapping Sleeves, Service Saddles and Tapping Valves.
9. Underground Pipe Markers.

B. Related Requirements:
1. Section 31 20 00 – EARTH MOVING

1.3 REFERENCES

A. ASTM International
1. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
2. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

B. American Water Works Association (AWWA)
1. AWWA C502 – Dry-Barrel Fire Hydrants
2. AWWA C504 – Rubber-Seated Butterfly Valves
3. AWWA C509 –Resilient-Seated Gate Valves for Water Service
4. AWWA C651 – Disinfecting Water Mains
5. AWWA C900 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

C. American National Standards Institute (ANSI)
1. ANSI A21.10 – Ductile-Iron and Gray-Iron Fittings
2. ANSI A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
3. ANSI A21.4 – Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
4. ANSI A21.5 – Polyethylene Encasement for Ductile-Iron Pipe Systems
5. ANSI A21.50 – Thickness Design of Ductile-Iron Pipe
6. ANSI A21.51 – Ductile-Iron Pipe, Centrifugally Cast

7. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800

D. Manufacturer's Standardization Society (MSS)
   1. MSS SP-60 – Connecting Flange Joints Between Tapping Sleeves and Tapping Valves

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product listed in Part 2 of this document:
   1. Include construction details, material descriptions, dimensions (with detailed drawings of assembled components) of individual components, and finishes for pipe, fittings, valves, hydrants.
   2. Include certification of factory testing conducted, indicating that the product meets or exceeds specified requirements of manufacture and performance, including factory applied finish or coating.
   3. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   4. Include plans, elevations, sections, and mounting details for back flow prevention assembly.
   5. Include product name, manufacturer and specifications of all coatings, protective finishes and encasement materials used as corrosion protection on pipes, fittings and appurtenances.

B. Fire Shop Drawings:
   1. Provide complete shop drawings for service lines and systems, including all required seismic restraints, pipe installed above grade, thrust block calculations and dimensions, and pipe support/restraints for pipes installed within any chase, duct, tunnel or channel or supported on a wall.

1.5 QUALITY ASSURANCE

A. Comply with requirements of
   1. City of Sausalito Standards and Details
   2. Marin County Water District Standards and Details
   3. Applicable sections of the National Fire Protection Association (NFPA) 24 and 13.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Do not store plastic pipe and fittings in direct sunlight.

C. Store pipe materials with adequate support to prevent sagging and bending.

D. Protect pipe, fittings, and seals from dirt and damage.

E. Protect flanges, fittings and metal specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Domestic Water Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of service on Owner's property.
   2. For service to others, obtain user's written permission no fewer than two days in advance of proposed service interruption and coordinate all shut downs with utility provider.

B. Interruption of Existing Fire Water Service: Do not interrupt service to facilities whether occupied or not by Owner or others unless appropriate fire suppression measures have been provided including:
   1. Notify Owner no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without City of Sausalito Fire Marshal's written permission.
   3. Appropriate alternate fire suppression measures approved by the Fire Marshal have been provided such as fire watch or other.

C. Coordination: Coordinate connections to existing water and fire service mains with the City of Sausalito and Marin County Water District as applicable.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Material for each type of service shall be as described below unless otherwise specified on the Drawings.

B. Domestic (potable) Water System:
   1. Pipe: High Density Polyethylene (HDPE) conforming to ASTM D3350
   2. Color: Carbon Black with Blue stripe
   3. Joints: Butt heat fusion per ASTM D3261
   4. Fittings: HDPE fittings
   5. Manufacturer: JM Eagle, ISCO, or approved equal.

C. Fire Water Service
   1. Pipe Option: AWWA C900, Class 235 Polyvinylchloride (PVC)
      a. Color: Blue
      b. Joints: Bell and spigot, push-on joints with factory installed elastomeric gasket meeting ASTM F477 requirements
      c. Manufacturer: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: JM Eagle, North American Pipe or approved equal.

   2. Pipe Option: Ductile Iron (DI) conforming to ANSI A21.50/51

a. Unless otherwise noted on the drawings, all Ductile Iron pipe shall be designed and manufactured with according to the following minimum design parameters: a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi and 10 percent minimum elongation.
b. Lining: Provide factory applied mortar cement lining in compliance with ANSI A21.4
c. Manufacturer: U.S. Pipe, American Cast Iron Pipe Co., or approved equal.

3. Joints: Except where specifically identified, joints may be either:
   a. Push-on, gasketed type, conforming to ANSI A21.11,
   b. Flanged, conforming to ANSI B16.1, Class 125,
   c. Mechanical Joint, conforming to AWWA C111
4. Fittings: Ductile Iron or Cast Iron fittings conforming to ANSI A21.10

5. Corrosion protection:
   a. If installed in a corrosive environment, DI or Cast Iron pipe and fittings must be polyethylene encased in conformance with ANSI A21.5
   b. Additional Cathodic Protection requirements per Geotechnical Engineer's findings and as recommended by Cathodic Protection Engineer.

D. Irrigation Water System (Potable):
1. Pipe: High Density Polyethylene (HDPE) conforming to ASTM D3350
2. Color: Carbon Black with Blue stripe
3. Joints: Butt heat fusion per ASTM D3261
4. Fittings: HDPE fittings
5. Manufacturer: JM Eagle, ISCO, or approved equal.

2.2 VALVES

A. Unless otherwise indicated, all buried valves shall be enclosed in an appropriately sized valve box or vault as detailed in the drawings.

B. Where direct buried valves are permitted, protective coating shall be provided consistent with the soil conditions in the immediate vicinity of the specific valve.

C. Gate Valves
1. Unless otherwise indicated on the drawings or elsewhere in these Specifications for specific applications, gate valves conforming to AWWA C509 shall be used for all water systems.
2. Body material, actuator, size, connection type and other specific properties shall be as indicated in the valve schedule.
3. Conforming to AWWA C509.
4. Pressure: To match minimum requirements of system for which is been installed. For Fire, use minimum 200 psi pressure or higher if required by City of Sausalito Fire.

D. Check Valves
1. Unless otherwise indicated in the valve schedule, swing check valves with ductile iron body shall be used.
2. Body material, disk material, size, connection type and other specific properties shall be as indicated in the valve schedule.

3. Conform to AWWA C508.
4. Pressure: 200 psi minimum or higher if required by City of Sausalito Fire.

2.3 FIRE HYDRANTS

A. Hydrant to be furnished shall be in conformance with AWWA C502 and in compliance with City of Sausalito Fire Department and Marin County Water District If there is a conflict between the standards referenced above, the more stringent requirements shall govern.

B. Hydrant shall be shop coated per local authority's requirements and specified color.

2.4 RESTRAINT SYSTEMS

A. Thrust restraint shall be provided at all locations so indicated on the drawings.

B. Thrust restraint shall be provided at all locations along pipelines under pressure at horizontal or vertical changes of direction, including Tees, Wyes, elbows and bends, plug ends, cross joints, etc., regardless of whether it has been so indicated on the drawings.

C. Thrust restraint shall be achieved through the use of either cast-in-place concrete thrust blocks or mechanically restrained joints, at the Contractor's discretion.

D. Thrust blocks shall be of mass concrete placed against undisturbed soil, and of a minimum size specified by the detail in the drawings for concrete thrust blocks.
   1. If trench soil surrounding pipe requiring thrust restraint has been disturbed, the Contractor shall over excavate in the area where the thrust block is required, to a sufficient depth and area to meet the requirements of the detail. Clean fill shall be placed in the excavation and compacted to 95% relative compaction prior to concrete placement.
   2. Wrap all pipe and fittings with polyethylene sheeting (4 mil minimum thickness) or similar acceptable corrosion barrier to prevent direct contact with concrete.

E. Mechanically Restrained Joints shall conform to AWWA C111. Where the installation of mechanically restrained joints is not indicated on the Plans, the Contractor shall furnish appropriate calculations documenting the required restrained length for each location of proposed use, in accordance with the joint manufacturer's recommendations.

2.5 TAPPING SLEEVES, SERVICE SADDLES AND TAPPING VALVES

A. Provide tapping sleeve, saddle or valve where indicated on drawings.

B. Tapping sleeve, saddle or valve shall be designed for tapping into pipe material found at indicated location, and shall be designed to withstand any reasonably anticipated pressure at installed location.

C. Tapping sleeves, service saddles and tapping valves shall provide flanged or mechanical joint connections.

D. Tapping sleeves, saddles and valves shall be stainless steel or factory coated with corrosion resistant finish.

2.6 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape:
   1. Brightly colored, continuously printed.
   2. Minimum 6 inches wide by 4 mil thick.
   3. Manufactured for direct burial service.

B. Trace Wire if using plastic pipe:
   1. Electronic detection materials for nonconductive piping products.
   2. Unshielded, [10 AWG] [10 gage]THWN-insulated copper wire.
   3. Conductive tape.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine each pipe section and component prior to installation for damage or deterioration or suitability for installation. Reject any component that is not in compliance with quality requirements, is missing the gasket, is broken or cracked, is the wrong size or length, or contains any unsatisfactory characteristic, paying particular attention to pipe ends. Any rejected component shall be removed from the project site as expeditiously as possible.

B. Notify Engineer immediately if rejection of materials or components may impact schedule.

C. Proceed with installation only after unsatisfactory conditions have been corrected, and all materials to be incorporated into the Work are free of defects.

3.2 INSTALLATION

A. Trench Excavation: Refer to 31 20 00 Earth Moving and applicable details on the drawings.

B. Shoring: Provide shoring where required by [29 CFR 1926.651 and 1926.652] [Cal/OSHA – Title 8, Subchapter 4, Article 6, Section 1541.1]

C. Bedding: Provide and compact pipe bedding as indicated in drawings and in Section 31 20 00 Earth Moving

D. Installation of pipe:
   1. Survey and stake pipe line and grade as necessary to assure proper installation per the drawings.
   2. Layout and install pipe in straight line runs between nodes.
      a. Where change in vertical alignment is required to avoid existing or proposed buried utilities, adjustment shall be made by routing the water line under the

crossing pipe using 45 degree bends, unless otherwise noted on the Drawings, or if the crossing pipe is a sewer line.

b. Where vertical adjustment is required to cross a sewer line, the Contractor shall conform the adjustment to Marin County Water District separation requirements.

c. All adjustments to vertical alignment shall maintain minimum cover as indicated below.

3. Maintain minimum separation of water lines from sewer lines as required by the City of Sausalito and Marin County Water District ordinance, standard or regulation.
4. Remove appropriate amount of bedding at bell joints, fittings and appurtenances to assure pipe lays flat with the full length and weight of the pipe material distributed approximately evenly along the length of each pipe section and without excess pressure on joints.
5. Establish pipe elevation with minimum cover of three (3) feet unless otherwise indicated on drawing.
6. Provide thrust restraint at each change of direction on all pressurized pipe. Place concrete for thrust blocks in such manner as to maintain full access to pipe and appurtenances.
7. Provide appropriate fittings to accommodate pressure testing, cleaning, flushing and disinfection of pipe as required.

E. Joint construction: Make pipe joints according to the following:
1. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
2. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
3. HDPE: Thermo-welded butt joints per manufacturer’s recommendations, flange joints where indicated.
4. Other pipe materials: Per manufacturer’s recommendations suitable to the application and pressure requirements.
5. Dissimilar Materials Piping Joints: Use approved adapters compatible with both piping materials, with OD, and with system working pressure.

F. Backfill:
1. Backfill pipe trench in pipe zone as described in Section 3120 00 Earth Moving, hand compacting below the haunch of the pipe and over the pipe.
2. Install pipe marker as shown in drawings for appropriate type of pipe material and type of utility as indicated above.
3. Perform hydraulic test of pipeline as described below prior to completion of backfill operation.
4. As soon as practical after the pipeline has passed the hydraulic testing, complete trench backfill according to Section 31 20 00.

G. Valves and Hydrants:

1. Set valves per applicable detail on drawings
2. Valve Box:
   a. Center and plumb valve box over valve.
   b. Set box cover flush with finished grade.

3. Set hydrants plumb. Locate pumper nozzle perpendicular to and facing roadway.
4. Hydrant installation shall conform to requirements of local fire protection agency.

H. Service Connections:
1. Make service connections to existing water service in accordance with the requirements of the local water service provider.
2. Install tapping sleeve, saddle or valve according to manufacturer's recommendations.
3. Install isolation valves as shown on drawings.

3.3 CLEANING, DISINFECTION AND FLUSHING

A. Flush pipeline with potable water until discharge water appears clean.

B. Disinfect pipeline and appurtenances in accordance with AWWA C651 – Disinfecting Water Mains.

C. Discharge disinfection water in compliance with local environmental regulations. Heavily chlorinated discharge water shall not be discharged to the environment, sewer or storm drain without first being appropriately dechlorinated. After dechlorination, provide chlorine residual test results and obtain approval of local authorities prior to discharge.

3.4 TESTING AND ACCEPTANCE

A. All fire water piping must be inspected by representatives of the Fire Marshal unless specifically excepted. The contractor shall give 72 hours' notice before backfilling.

B. Pressure test each pressurized water system according to AWWA C600 and following:
1. Test Pressure: Not less than 200 psig or 50 psi in excess of maximum static pressure, whichever is greater.
2. Conduct hydrostatic test for at least two hours.
3. Slowly fill with water section to be tested and expel air from piping by installing corporation cocks at high points.
4. Close air vents and corporation cocks after air is expelled and raise pressure to specified test pressure.
5. Observe joints, fittings, and valves under test. Remove and renew cracked pipes, joints, fittings, and valves showing visible leakage and retest.
6. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
7. Maintain pressure within plus or minus 5 psi of test pressure.
8. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
9. Compute maximum allowable leakage using following formula:
a. L = SD x sqrt(P)/C.

a. L = testing allowance, gph .
b. S = length of pipe tested, feet.
c. D = nominal diameter of pipe, inches .
d. P = average test pressure during hydrostatic test, psig .
e. C = 148,000 .

b. If pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

10. If test of pipe indicates leakage greater than that allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
11. Correct visible leaks regardless of quantity of leakage.

C. System or specified components of the system will be considered defective if it does not pass tests and inspections.

D. The Contractor shall submit test and inspection reports for all field testing for which the Contractor is responsible.

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SECTION 33 3100
SANITARY SEWERAGE PIPING

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 SUMMARY

A. Section includes:
   1. Gravity Sewer Pipe and Appurtenances
   2. Pressure Sewer Pipe and Appurtenances
   3. [**Other**]

B. Related Requirements:
   1. Section 31 20 00 – Earth Moving
   2. Section 31 23 33 – Trenching and Backfill

1.3 REFERENCES

A. ASTM International (ASTM)
   1. ASTM A74 – Standard Specification for Cast Iron Soil Pipe and Fittings
   2. ASTM A746 – Standard Specification for Ductile Iron Gravity Sewer Pipe
   3. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manholes
   4. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
   5. ASTM D3350 – Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
   6. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.4 ACTION SUBMITTALS

A. General:
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for pipes, fitting and valves.
   2. Include certification of factory testing conducted, indicating that the product meets or exceeds specified requirements of manufacture and performance, including factory applied finish or coating.
   3. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   4. Include product name, manufacturer and specifications of all coatings, protective finishes and encasement materials used as corrosion protection on pipes, fittings and appurtenances.

B. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Comply with requirements of
   1. [ity of Sausalito tandards and Details

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Do not store plastic pipe and fittings in direct sunlight.

C. Store pipe materials with adequate support to prevent sagging and bending.

D. Protect pipe, fittings, and seals from dirt and damage.

E. Protect flanges, fittings and metal specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. Interruption of existing sanitary sewer service: Do not interrupt sanitary sewer service to upstream users.

B. Temporary interception of sewer service, during non-peak hours, may be allowed with coordination and approval of local authorities having jurisdiction/ownership of sewer line, provided upstream sewer pipe has sufficient capacity to contain anticipated flows for the full duration of the work prior to reconnection, with a safety factor of [2].

C. Bypass piping: If capacity of upstream system is not sufficient to contain flows for full duration of work prior to reconnection (with above stated safety factor), the Contractor shall provide bypass piping and pumping to direct flows around area of work. Bypass piping/pumping shall be subject to local authority coordination and approval. Bypass system shall be in place prior to commencement of work on line(s) being bypassed. Bypass system shall be constructed and maintained with zero leakage to the environment. The Contractor shall provide sufficient protection and inspection of bypass piping to assure zero leakage to the environment. The Contractor shall be wholly responsible for cleanup costs of any violation of this requirement.

PART 2 - PRODUCTS

2.1 GRAVITY SEWER PIPE MATERIALS

A. Polyvinyl Chloride (PVC) Gravity Sewer Pipe
   1. Conforms to ASTM D3034 for 4” through 15” diameter pipe, SDR 35/26
   2. Conforms to ASTM F679 for 18” through 60” diameter pipe, 46PS/115PS
   3. Joints shall be push on type, integrally molded bell / spigot with elastomeric gasket that conforms to ASTM D3212.
   4. Pipe shall be marked with manufacturer’s name, pipe size and class.
   5. Color: Green

6. As manufactured by JM Eagle, North American Pipe Corp., Diamond Plastics Corp. or approved equal.

2.2 PIPE ACCESSORIES

A. Flexible Couplings
   1. Sleeve type flexible couplings as approved by the [Engineer].
   2. Sized to be compatible with O.D. of pipes on which it is installed. In the event of different materials/ pipe diameters, select an appropriately sized eccentric coupling such that when the pipe is installed, the inverts match.
   3. For buried installations, bolts shall be stainless steel.
   4. Standard lengths unless otherwise noted.
   5. As manufactured by Dresser Industries, R. H. Baker, Inc., Smith-Blair, Inc., or equal.

B. [**Insert other fittings or appurtenances here**]

2.3 PRECAST REINFORCED CONCRETE MANHOLES

A. Section Reserved – PRECAST CONCRETE MANHOLES AND VAULTS
   1. ASTM C76

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting performance of the Work.

B. Verify location of existing utilities and any other buried or structural elements to assure that line and grade of proposed sewer installation is constructible as designed, prior to installation. If conflicts are found, notify the [Engineer] immediately upon discovery of the conflict. Provide the [Engineer] with exact coordinates, depth, type, material and condition of conflict.

C. Proceed with installation only after unsatisfactory conditions have been corrected and the [Engineer] has approved realignment or relocation of line, grade, manholes and appurtenances.

3.2 INSTALLATION

A. Trenching shall be completed in accordance with Section 31 2333 – Trenching and Backfill Refer to the geotechnical report for trenching requirements.

B. Bedding shall be completed in accordance with the appropriate detail in the drawings and per the directions from the geotechnical engineer. Under all conditions, pipe shall be placed true to line and grade. Bell holes, where bell and spigot pipe is installed, shall be formed in the bedding such that the pipe lays flat in the trench and is fully supported.

C. Pipe, fittings and appurtenances shall be installed per manufacturer's recommendations. The Contractor shall furnish all materials, whether specified herein or not, to comply with the manufacturer's recommendations.

D. Pipe shall be backfilled in accordance with Section [31 233 – TRENCHING AND BACKFILL], taking care to protect the pipe from damage, from deformation, and assuring that the backfill is properly placed and compacted below the haunch of the pipe. Materials shall be as specified and shall have the moisture content within the allowable range when placed. Jetting is not permitted to achieve backfill compaction.

E. Pipes shall be laid with the bell end facing upstream, spigot end pointing downstream and in such a sequence as to eliminate or minimize "specials" or incorporation into the Work of partial pipes that do not have factory formed joint ends.

F. Protect exposed ends, vaults and manholes during installation from accumulating dirt and debris. Do not allow mortar, mastic, cement or other such material to splatter, drop or collect in the system long enough to set. Remove all dirt and debris immediately and cover openings when not working in them.

G. Manholes and vaults shall be precast reinforced concrete per this section.

H. [Retain "Piping Restraint Installation" Paragraph below if piping is required to withstand seismic design loads…note that you do not need this paragraph if all your pipe is buried.

I. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in [Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."] [Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."]

J. Comply with requirements for pipe hangers and supports specified in [Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."]

K. Comply with requirements for general-duty valves specified in [Section 220523 "General**-Duty Valves for Plumbing Piping."**]

3.3 CONNECTIONS

A. Connections of laterals to existing or proposed sewer lines, whether mains or other laterals, shall be made only within manholes unless specifically indicated otherwise on the Drawings.

B. Connections to manholes shall be made as described in the details on the Drawings

3.4 IDENTIFICATION

A. Tracer tape or wire shall be installed as indicated in the Drawings.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Testing and acceptance per City of Sausalito requirements.

B. Clean and remove all dirt, dust and debris from pipeline, manholes, vaults and other components of the system prior to testing.

C. Prepare test and inspection reports.

END OF SECTION

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SECTION 33 41 00
STORM UTILITY DRAINAGE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Storm drainage piping.
   2. Piping accessories.
   3. Catch basins and area drains.
   4. Cleanouts.
   5. Bedding and cover materials.

B. Related Requirements:
   1. Section 31 20 00 – Earth Moving:
   2. Section 31 23 33 - Trenching: and Backfilling

1.2 REFERENCE STANDARDS

A. ASTM International:
   1. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer information describing pipe, pipe accessories, and structures.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication.
   2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Drainage pipe shall be dual wall high density polyethylene (HDPE) made from virgin material that conforms to the minimum requirements of cell classification 42440C for 4 inch through 10 inch diameters, and to 435400C for larger sizes
   1. Pipe shall conform to AASHTO M252, Type S or to AASHTO M294, Type S, as applicable for the pipe size.
   2. Pipe shall have a smooth interior and annular exterior corrugations.

3. Couplings shall be silt-tight, conforming to the requirements of AASHTO M252, AASHTO M294, or ASTM F2306.
4. Available Manufacturers:
   a. Hancor Systems
   b. ADS, Inc. – "N-12"
   c. Or approved equal.

2.2 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Concrete Pipes: ASTM C 443, rubber.
   2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.3 CLEANOUTS

A. Cast-Iron Cleanouts:
   1. Manufacturers:
      a. Smith, Jay R. Mfg. Co.
      b. WADE
      c. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
      d. Or equal.
   2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, water-tight brass cover with the word "STORM" on the cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
   3. Top-Loading Classification(s): Medium Duty in Foot-traffic/landscape areas, Heavy Duty in vehicle-traffic areas.
   4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.4 PRECAST CONCRETE DROP INLETS AND OVERFLOW STRUCTURES

A. Standard Precast Concrete Drop Inlet/Catch Basin Structures:
   1. Manufacturers:
      a. Oldcastle Precast.
      b. Jensen Precast.
      c. Or approved equal.
   2. Description: ASTM C 478, precast reinforced concrete, of depth indicated, with provision for sealant joints. Square in shape.
   3. Base Section: 6-inchminimum thickness for floor slab
   4. Riser Sections: 4-inch minimum thickness for walls and base riser section.
   5. Dimensions: as indicated on the plans
   6. Pipe connectors: ASTM C 923resilient, of size required, for each pipe connecting to base section

B. Frames and Grates:
   1. General: All structures identified as Drain Inlets (DI) or Outfall Structures on the Plans shall have open grates. All structures identified as a Junction Box (JB) shall have a solid lid. Refer to the Plans.
   2. All grates and covers must be match-marked so they fit snugly in the frame and do not rock upon completion.
   3. All grates and covers within the path of travel must be ADA compliant.
   4. All grates and covers within vehicle-traffic areas must be designed for H20 loading.
   5. Drop inlet structures located within new paving shall have an adjustable steel paving notch frame that allows for pavement to be installed up to the frame.
   6. Covers/Grates to be cast nodular iron, cast steel, welded, bolted, or cast end block grate.
   7. Manufacturers:
      a. Neenah Foundry.
      b. Urban Accessories.
      c. Or equal.

2.5 AREA DRAINS AND GRATES

A. PE Atrium Drop-In Grates (within landscape areas only):
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. NDS
      b. Hancor Technology Innovation Solutions
      c. Or equal.
   2. Description: Plastic round body with atrium drop-in grate made to fit round basins, corrugated dual wall pipe)
      a. Color: Black
      b. Sizes and locations per the Plans.

B. Square Drop-In Grates (within paved areas only);
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. NDS
      b. Hancor Technology Innovation Solutions
      c. Or equal.
   2. Description: Square drop-in grate made to fit round basins, corrugated dual wall pipe.
      a. Material/Color/finish: Nickel bronze (preferred) or satin brass.
      b. Sizes and locations per the Plans.
      c. ADA-compliant grates

PART 3 - EXECUTION

3.1 TRENCHING

A. Excavation, trenching, and backfilling are specified in Section 31 23 17 - Trenching.

3.2 PIPING APPLICATIONS

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install gravity-flow, nonpressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
   2. Install piping with 36-inch minimum cover within vehicular areas unless otherwise noted on plans, and with 18" minimum cover within earth or unpaved foot-traffic areas unless otherwise noted on plans.
   3. Install PE corrugated sewer piping according to Corrugated Polyethylene Pipe Association’s (CPPA) "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."
   4. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.4 PIPE JOINT CONSTRUCTION

A. Follow piping manufacturer's written instructions for pipe joint construction.

B. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join corrugated PE piping according to CPPA 100 and the following:
      a. Use silt-tight couplings for Type 2, silt-tight joints.
   2. Join dissimilar pipe materials with nonpressure-type flexible couplings.
   3. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast iron pipe fittings in sewer pipes at branches for cleanouts and cast iron pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.

3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in concrete or asphalt pavement with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
1. Use Medium-duty, top-loading classification drains in paved foot-traffic areas and landscape areas.
2. Use Heavy-duty, top-loading classification drains in vehicle-traffic service areas.
3. Use heel-proof/ADA compliant grates in all paved areas.

B. Fasten grates to drains as recommended by the manufacturer for landscape area drains.

C. For landscape planters, set atrium drains in accordance with elevations shown in the Plans.

D. Bioretention and Self-Retaining Area Overflow Drain Installation:
1. Set rim of overflow drains in accordance with elevations shown on the Plans.
2. Place river rock around each overflow to form an 18-inch minimum wide rock collar to prevent erosion at the base of the structure. Contractor to coordinate with the Landscape Architect on rock type.

3.7 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Form concrete channels to dimensions indicated on the ings to slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer if necessary.

C. Fasten grates to frames, channel as indicated by manufacturer's specifications and on drawings.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm drains to on-site drain lines as specified in Section 22 14 13 Facility Storm Drainage Piping.

B. Make connections to existing and proposed underground structures as follows:
1. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase

entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psiunless otherwise indicated.
   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Unshielded flexible couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.9 IDENTIFICATION

A. Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test plastic piping according to requirements of authorities having jurisdiction, UNI-B-6, and ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION

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