Project No.: 906550

Specifications
for
North Bowl Parking Phase 2
Volume 1 of 1

University of California
Merced Campus
Merced County
Merced, California

Siegfried Engineering, Inc.
3244 Brookside Road, Ste 100
Stockton, CA 95219

CERTIFICATION

Name of Project: **North Bowl Phase 2**

Bidding Documents Prepared By:

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Signed: _____

(Signature of a Representative of the Firm Named Above)

Date:

Typed Name: Paul J. Schneider, P.E.

Title: Vice President

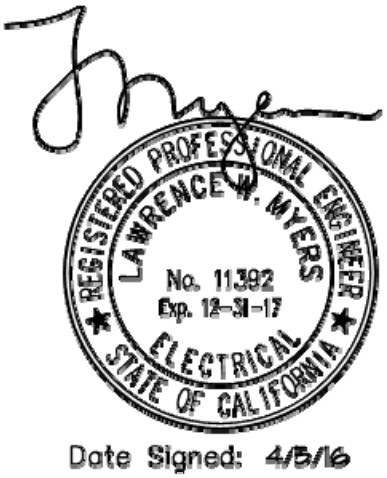
Certification: **(Affix professional registration stamp of the person named above with Signature and expiration date.)**

REGISTERED PROFESSIONAL ENGINEER
PAUL J. SCHNEIDER
No. 62498
Exp. 09/30/17
CIVIL
STATE OF CALIFORNIA

Date Signed: 4/5/16

SECTION 00007 – SEALS PAGE

THE SPECIFICATIONS CONTAINED HEREIN HAVE BEEN PREPARED BY OR UNDER THE DIRECITON OF THE FOLLOWING PERSONS:



Date Signed: 4/5/16

Stanton Engineering – Lawrence W. Myers

_____

NAME OF ELECTRICAL ENGINEERING

PLACE SEAL

FIRE MARSHAL CERTIFICATION

Name of Project: **NORTH BOWL PARKING PHASE 2**

UNIVERSITY OF CALIFORNIA
MERCED
FIRE MARSHAL

CDF-OFFICE OF STATE FIRE MARSHAL
APPROVED

Approval of this plan does not authorized or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection One set of approved plans shall be available on the Project site at all times.

Reviewed by: _____

Date: _____

Project #: _____

Authorization #: COOO1

Typed Name: GINI KRIPPNER

Title: University of California, Merced, FIRE MARSHAL

Certification: **(Affix professional registration stamp of the person named above with Signature and expiration date.)**

Section 03 20 00 – Reinforcement Steel .....
Section 03 32 00 – Sitework Cast-In-Place Concrete .....
Section 23 05 00 – Basic Electrical Requirements.....
Section 26 05 19 – Building Wire and Cable .....
Section 26 05 26 – Grounding and Bonding .....
Section 26 05 43 – Underground Ducts and Structures .....
Section 26 24 14 – Integrated Distribution Assemblies .....
Section 26 24 16 – Panelboards .....
Section 26 28 17 – Overcurrent Protective Devices.....
Section 27 00 00 – Communications Basic Requirements.....
Section 27 05 26 – Communications Grounding and Bonding.....
Section 27 05 28 – Communications Pathways .....
Section 27 05 30 – Communications Identification .....
Section 27 13 14 – Communications Backbone OSP Twisted Pair Cabling.....
Section 27 15 13 – Communications Structured Cabling, Basic Materials and Methods.....
Section 27 20 00 – Communications Terminations Blocks and Patch Panels .....
Section 27 50 00 –Ring-Down Emergency Telephones.....
Section 31 10 00 – Site Clearing.....
Section 31 22 00 – Earthwork.....
Section 31 22 19 – Finish Grading.....
Section 31 23 33 – Trenching and Backfill.....
Section 32 12 13 – Flexible Pavement.....
Section 32 15 00 – Gravel Surfacing .....
Section 31 17 23 – Pavement Markings and Signs .....
Section 33 10 00 – Water Distribution.....
Section 33 40 00 – Storm Drainage.....

SECTION 032000- REINFORCING STEEL

PART 1- GENERAL

1.1 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all work of this Section.

1.2 SCOPE

A. Unless noted otherwise, furnish and install reinforcing for all concrete, including dowels, chairs, spacers, bolsters, etc., necessary for supporting and fastening reinforcement in place as shown on the Drawings and specified herein.

1.3 RELATED WORK (See also Table of Contents)

A. Cast-In-Place Landscape Concrete: Section 03 32 00.

1.4 QUALITY ASSURANCE

A. General:

1. Acceptable Manufacturers: Regularly engaged in the manufacture of steel bar and welded wire fabric reinforcing.

2. Installer Qualifications: Installation shall be done only by an installation firm normally engaged in this business. All work shall be performed by qualified mechanics working under an experienced supervisor.

3. Welding Qualifications: Welding procedures, welding operators and welders shall be qualified in accordance with AWS D1.4 - "Structural Welding Code Reinforcing Steel".

   a. Welders whose work fails to pass inspection shall be re-qualified before performing further welding.

4. Reinforcement Work shall conform to ACI 301 and CBC Section 1907, as minimum standards.

5. Allowable Tolerances:

   a. Fabrication:
      1) Sheared length: 1 inch.
      2) Depth of truss bars: Plus 0 minus ½-inch.
      3) Ties: Plus or minus ½-inch.
      4) All other bends: Plus or minus 1 inch.

   b. Placement:
      1) Concrete cover to form surfaces: Plus or minus ¼-inch.
      2) Minimum spacing between bars: Plus or minus ¼-inch.

3) Crosswise of members: Spaced evenly within 2 inches of stated separation.
4) Lengthwise of members: Plus or minus 2 inches.

c. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 2 bar diameters.

B. Standards and References: (Latest Edition unless otherwise noted):

1. American Concrete Institute (ACI).

a. ACI 301 - "Specifications for Structural Concrete for Buildings".

b. ACI 315 - "Details and Detailing of Concrete Reinforcing".

c. ACI 318 – “Building Code Requirements for Reinforced Concrete”

2. American Society for Testing and Materials (ASTM).

a. ASTM A82 - "Cold Drawn Wire for Concrete Reinforcement".

b. ASTM A185 - "Welded Steel Wire Fabric for Concrete Reinforcement".

c. ASTM A615 - "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".

d. ASTM A706 – “Low Alloy Steel Deformed Bars for Concrete Reinforcement”.

3. Concrete Reinforcing Steel Institute (CRSI) - "Manual of Standard Practice".

4. 2010 California Building Code (CBC),.

C. Submittals: (Submit under provisions of Section 01 33 23)

1. Shop Drawings: Prepare in accordance ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars and shapes, dimensions and details of bar reinforcing and assemblies. Correctness of all reinforcing requirements and work is the responsibility of Contractor. Identify such shop drawings with reference thereon to sheet and detail numbers from Contract Drawings.

a. Do not use scaled dimensions from Contract Drawings in determining the lengths of reinforcing bars.

b. No reinforcing steel shall be fabricated without approved shop drawings.

c. Any deviations from the contract documents must be clearly indicated as a deviation on the shop drawings.

d. Areas of high congestion, including member joints and embed locations shall be fully detailed to verify clearances and assembly parameters and

coordination with other trades.

2. Certified mill test reports of supplied reinforcing indicating chemical and physical analysis. Tensile and bend tests shall be performed by the mill in accordance with ASTM A615.

3. Product Data:

   a. Manufacturer's specifications and installation instructions for splice devices.

   b. Bar Supports.

4. Certificates of Compliance with specified standards:

   a. Reinforcing bars.

   b. Welded wire fabric.

   c. Welding electrodes.

5. Samples: Only as requested by Design Professional.

D. Tests and Inspections:

1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2007 CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, University and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.

2. All reinforcing steel whose properties are not identifiable by mill test reports shall be tested in accordance with ASTM A615. One Series of tests for each missing report to be borne by the Contractor.

3. When inspections are indicated for reinforcement placement on the Structural drawings, a special inspector shall be employed to inspect reinforcing placement per CBC Section 1704.

4. When tests are indicated for reinforcing steel on the structural drawings, the reinforcing steel used shall be tested in accordance with ASTM A615. One tensile and one bend test for each 2-1/2 tons of steel or fraction thereof, shall be made.

5. Inspect shop and field welding in accordance with AWS D1.4, including checking materials, equipment, procedure and welder qualification as well as the welds. Inspector will use non-destructive testing or any other aid to visual inspection that he deems necessary to assure himself of the adequacy of the weld.

6. Tests and inspection shall be performed by the University’s testing agency except when needed to justify rejected work, in which case the cost of retests and

reinspection shall be borne by the Contractor.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement to project site in bundles marked with metal tags indicating bar size and length.

B. Handle and store materials to prevent contamination.

1. Store reinforcement in a manner that will prevent excessive rusting or coating with grease, oil, dirt, and other objectionable materials. Storage shall be in separate piles or racks so as to avoid confusion or loss of identification after bundles are broken.

C. Deliver and store welding electrodes in accordance with AWS D12.1.

PART 2- PRODUCTS

2.1 MATERIALS

A. Reinforcement Bars: ASTM A615, Grade 40 for No. 3 and smaller bars; ASTM A615, Grade 60 for No. 4 and larger bars.

1. Bar reinforcement to be welded shall meet chemical requirements of ASTM A706.

B. Stirrups and Ties: ASTM A615, Grade 60 for No.4 and larger bars, ASTM A615, Grade 40 for No. 3 and smaller bars.

C. Steel Dowels: Same grade as bars to which dowels are connected.

D. Welded wire Fabric: ASTM A185.

E. Tie Wires: FS-QQ-W-461, annealed steel, black, 16 gauge minimum.

F. Welding Electrodes: AWS D1.4, low hydrogen, E70XX series.

G. Bar Supports:

1. Typical, unless noted otherwise; CRSI Class 2 wire supports.

a. Do not use wood, brick or other objectionable materials.

b. Do not use galvanized supports.

2. Supports placed against ground: Pre-cast concrete blocks not less than 4 inches square with embedded wire.

H. Mechanical Couplers: Comply with ACI 318 section 12.14.3.

PART 3- EXECUTION

3.1 FABRICATION

A. Shop fabricate reinforcement to meet requirements of Drawings.

B. Fabricate reinforcement in accordance with the requirements of ACI 315 where specific details are not shown or where Drawings and Specifications are not more demanding.

C. Steel reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of bars for bending will not be permitted.

D. Reinforcing shall not be field bent or straightened without Design Professional's review.

E. Provide offsets in rebar (1:6 maximum) where required to maintain clearances.

3.2 CONDITION OF SURFACES

A. Examine surfaces and conditions receiving or affecting the work. Do not proceed until unsuitable conditions have been corrected.

3.3 GENERAL

A. Concrete shown without reinforcing shall be reinforced as similar parts shown with reinforcing except where concrete is specifically noted to be unreinforced.

3.4 PLACEMENT

A. All reinforcement shall be accurately set in place, lapped, spliced, spaced rigidly and securely held in place and tied with specified wire at all splices and crossing points. All wire tie ends shall point away from the form. Carefully locate all dowel steel to align with wall and column steel.

1. Bars shall be in long lengths with laps and splices as shown. Offset laps in adjacent bars. Place steel with clearances and cover as shown. Bar laps shall be as indicated on the Drawings. Tie all laps and intersections with the specified wire.

2. Maintain clear space between parallel bars not less than 1-1/2 times nominal diameter, but in no case shall clear space be less than 1-1/2 times maximum size concrete aggregate.

3. Reinforcing dowels for slabs shall be placed as detailed. Sleeves may be used if reviewed by the Design Professional before installation. Install dowel through all construction and expansion joints for all slabs on grade.

B. Bar Supports: Support and securely fasten bars with chairs, spacers and ties to prevent displacement by construction loads or placement of concrete beyond the tolerances specified. Conform to CRSI as a minimum standard.

C. Steel Adjustment:

1. Move within allowable tolerances to avoid interference with other reinforcing steel, conduits, or embedded items.

2. Do not move bars beyond allowable without concurrence of Design Professional.

3. Do not heat, bend, or cut bars without concurrence of Design Professional.

4. Reinforcement shall not be bent after being embedded in hardened concrete.

D. Splices:

1. Splice reinforcing as shown.

2. Lap Splices: Tie securely with wire to prevent displacement of splices during placement of concrete.

3. Splice Devices: Install in accordance with manufacturer's written instructions. Obtain Design Professional’s review before using.

4. Do not splice bars except at locations shown without concurrence of Design Professional.

a. Where splices in addition to those indicated are required, indicate location on shop drawings clearly and highlight "for Design Professional’s approval".

E. Welding:

1. Welding is not permitted unless specifically detailed on Drawings or approved by Design Professional.

2. Employ shielding metal-arc method and meet requirements of AWS D1.4.

3. Welding is not permitted on bars where the carbon equivalent is unknown or is determined to exceed 0.55.

4. Welding shall not be done within two bar diameters of any bent portion of a bar which has been bent cold.

5. Welding of crossing bars is not permitted.

F. Welded Wire Fabric: Install in long lengths, lapping 24 inches at end splices and one mesh at side splices. Offset laps in adjacent widths. Place fabric in approximately the middle of the slab thickness unless shown otherwise on the Drawings by dimension. Wire tie lap joints at 12-inch centers. Use concrete blocks to support mesh in proper position.

G. Reinforcement shall be free of mud, oil or other materials that may reduce bond at the time concrete is placed. Reinforcement with tightly adhered rust or mill scale will be accepted without cleaning provided that rusting has not reduced dimensions and weights below applicable standards. Remove loose rust.

H. Protection against rust:

1. Where there is danger of rust staining adjacent surfaces, wrap reinforcement with impervious tape or otherwise prevent rust staining.

2. Remove protective materials and clean reinforcement as required before proceeding with concrete placement.

I. Drawing Notes: Refer to notes on Drawings for additional reinforcement requirements.

J. Mechanical and Electrical Drawings: Refer to Mechanical and Electrical Drawings for formed concrete requiring reinforcing steel. All such steel shall be included under the work of this Section.

END OF 03 20 00- REINFORCING STEEL

SECTION 03 32 00 - SITEWORK CAST-IN-PLACE CONCRETE

PART 1- GENERAL

1.1 DESCRIPTION

A. This Section includes site concrete, including but not limited to pavements, walls, footings and sub slabs, complete, as shown and as specified.

B. Furnish all labor, materials, equipment, and services to complete the work as indicated on the drawings, and in accordance with these specifications. Work includes but is not limited to the following:

1. Concrete formwork

2. Concrete reinforcement

3. Cast-in-place concrete items:

a. Concrete paving, sidewalks, ramps, pads, curbs, mow bands, etc.

b. Miscellaneous concrete.

c. All imbeds including anchor bolts, tiedowns, hold downs with bolts, straps, and sleeves.

1.2 REFERENCES

A. Standard Specifications - Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS, latest edition.

B. ASTM - American Society for Testing and Materials

C. ACI - American Concrete Institute, Manual of Concrete Practice.

D. CBC – California Building Code

1.3 DEFINITIONS

A. Percent Compaction: ASTM D1557, percentage of the maximum in-place dry density of the same material as determined by the Geotechnical Report.

1.4 SUBMITTALS

A. Conform to the requirements of Division 1, Section 01 33 23 Shop Drawings, Product Data, and Samples.

B. Product Data: Manufacturers' current catalog cuts and specifications for the following:

1. Expansion joint filler, sealant, backer rod and bond breaker.

2. Damp proofing material.

3. Air-entrainment.

4. Curing Compound.

5. Fly Ash or Slag

6. MDO plywood made for forming

C. Samples:

1. Joint Sealant: Color chart.

2. MDO plywood made for forming, (1) 6”x 6” piece

D. Certificates:

1. Reinforcing Steel: Certificate of compliance

2. Concrete Mix Design: Ticket for each batch delivered showing the following:

a. Mix identification.

b. Weight of cement, aggregate, water, and admixtures, aggregate sizes/proportion, and air entrainment.

1.5 QUALITY ASSURANCE

A. Comply with American Society for Testing Materials (ASTM) A-615 "Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement," and "Manual of Standard Practice for Detailing Reinforced Concrete Structures," publication American Concrete Institute (ACI) 315-65 of the American Concrete Institute.

B. Comply with all pertinent recommendations contained in ACI, "Recommended Practice of Concrete Formwork, ACI-347", and Section 2606, 1997 California Building Code (CBC).

C. Construct forms to sizes, shapes, lines and dimensions indicated on Drawings, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in Work. Use selected materials to obtain required finish. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Provide complete forms of such strength and construction as to prevent any spread, shifting, or settling when concrete is deposited, and tight enough to avoid any leakage or washing out of cement mortar.

E. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all Work performed under this Section. For

finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeymen concrete finishers.

F. Conform to Section 90 of the "Standard Specifications of the State of California", Business and Transportation Agency, Department of Transportation (CSS), latest edition.

G. The contractor shall contact University's Representative of any discrepancies between field conditions and plans prior to proceeding with Work. The written dimension on Drawings shall supersede the graphic presentation. Dimensions are from back of curb, center line, base lines or as noted on the plans. All field adjustments must be approved by University's Representative prior to installation.

H. All walks and curbs shall be established in the field for review and approval prior to concrete pours. The contractor shall layout the area or form work for review by University's Representative. If approval is not obtained, the contractor is responsible for removal of any unauthorized field adjustments.

I. Transitions of curves to other curves, and curves to straight line tangents, shall be smooth and continuous.

J. Place expansion joint and score joints as shown on plan. Adjustments in the field shall be made only with the approval of University's Representative.

K. Where new concrete paving is placed adjacent to curbs or existing concrete paving, a continuous expansion joint shall be installed between the new concrete paving and curbs or existing concrete paving.

L. Sleeving shall be coordinated with concrete work. Refer to irrigation plan for sleeving location.

M. The Contractor shall be responsible for repairing, at no additional cost to University, any disturbed existing landscape designated to remain which resulted from construction of this project.

N. All materials and finishes shall be as per the Drawings, details and Specifications. Some materials may require a several week order lead time. Contractor is responsible for determining any and all ordering lead times, and providing required materials at the project site in a timely manner. No unapproved substitutions will be allowed. Contact University's Representative immediately if a specified material is not available.

O. Mock-up: Refer to specification Section 01 43 39 Mock-Ups for submittal requirements.

1. One [1] 5 ft. section of concrete wall as detailed in drawing. Mock up shall include all jointing details and insets (skate deterrents) for acceptance.

2. One [1] 5 ft square paving mock up for each paving concrete paving type as detailed on the drawings. Mock up shall included finish, jointing, thickness, and edging.

3. Approved mock-up shall serve as a standard of quality for judging the acceptance of landscape concrete paving on the Project and may remain as part of the work.

P. Lines and Levels: To be established by a licensed Surveyor or registered Design Professional.

Q. Mix Standards: Conform to the ACI Manual and the Portland Cement Association's "Design and Control of Concrete Mixes".

R. Design of Concrete Mix: Employ approved commercial testing laboratory to design concrete mixes as follows:

Item	Minimum Cement Content	28-Day Minimum Strength	Max. Slump	Aggregate Size	Water to Cement Ratio Max. Gal/Bag
Slabs on Grade, Curbs, Exterior Walkways	540 lb/cu. yd	3,500 PSI	3 in.	¾ in	SIX
Walls and Footings	540 lb/cu yd.	4,000 PSI	2-1/2 in.	¾ in	FIVE

All site work concrete shall have a minimum 5 day strength of 2,500 psi.

S. Fly Ash:

1. Source Control: The following sources of ash are not to be used:

   a. Ash from a peaking plant instead of a base loaded plant.

   b. Ash from plants burning different coals or blends of coal.

   c. Ash from plants burning other fuels (wood chips, tires, trash) blended with coal.

   d. Ash from plants using oil as a supplementary fuel.

   e. Ash from plants using precipitator additives, such as ammonia.

   f. Ash from start-up or shut-down phases of operation.

   g. Ash from plants not operating at a "steady state."

   h. Ash that is handled and stored using a wet system.

2. Fly ash used in concrete should be as consistent and uniform as possible. Fly ash to be used in concrete should be monitored by a quality assurance/quality control (QA/QC) program that complies with the recommended procedures in ASTM C311.(6) These procedures establish standards for methods of sampling and frequency of performing tests for fineness, loss on ignition (LOI), specific gravity, and pozzolanic activity such that the consistency of a fly ash source can be certified.

1.6 QUALIFICATION OF INSTALLER

A. Installer shall be thoroughly trained and experienced in the skills required, and shall be completely familiar with the products and their installation as specified on the Drawings and in this Section. Installer shall be present at all times during progress of Work of this Section and shall direct all Work performed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivered Mixes: Coordinate delivery so that mixes may be immediately poured upon arrival at site.

B. Components and Accessories:

1. Fittings and Reinforcements: Protect from rust, soil and oil contamination at all times. Store on pallets above ground.

2. Templates: Protect from damage. Test accuracy prior to each use.

1.8 PROJECT/SITE CONDITIONS

A. Existing Conditions: For protection of existing plants to remain, see Division 1, Section 01 56 39 Tree and Plant Protection.

B. Water and Dust Control: Maintain control of concrete dust and water at all times. Do not permit adjacent planting areas to be contaminated. Clean up all debris resulting from this work at the end of each day's work.

1.9 SEQUENCING AND SCHEDULING

A. Coordination: Coordinate all items of other trades to be furnished and set in place. Coordinate 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 in ample time that progress of the work is not delayed.

B. Cutting/Patching: Perform as necessary to comply with above injunction.

1.10 JOB CONDITIONS

A. Cold-Weather Placement: comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

B. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators.

C. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray form, reinforcing steel, and subgrade just before placing concrete. Keep subgade moisture uniform without puddles or dry areas.

1.11 COORDINATION

A. Secure all pipe sleeves, anchors and bolts, including those for angle frames, inserts, ties and other materials in connection with concrete construction, in position before concrete is placed.

B. Obtain information and instructions from other Trades and suppliers in ample time to schedule and coordinate the installation of items furnished by them to be embedded in concrete so provisions for their work can be made without delaying the project.

C. Make cutting and/or patching made necessary by failure or delay in complying with these requirements at no additional cost to the University.

1.12 FORM CONSTRUCTION TOLERANCES

A. Set form to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of Work so that forms can remain in place for twenty-four hours after concrete placement.

B. Check completed formwork for grade and alignment to following tolerances:

C. Top of forms not more than one-eighth inch in ten feet vertical elevation.

D. Vertical face on longitudinal axis not more than one-fourth inch in ten feet horizontal width.

E. Circular or curved formwork shall be continuous, complete radii as indicated on Drawings. No straight segments in circular/curved formwork shall be accepted.

1.13 TESTS AND OBSERVATIONS

A. The following tests shall be made by University's testing laboratory.

1. Cement: Mill analysis and test reports by supplier certifying cement conforms to Specifications is acceptable in lieu of tests at the discretion of University's Representative.

2. Concrete cylinders: Make and cure in accordance with ASTM C31.

   a. Record shall be made of the time cylinders were made and of locations of concrete from which the cylinders were taken.

   b. Three identical cylinders shall be taken from each pour of 75 to 100 cubic yards or part thereof, being placed each day. One cylinder shall be tested at five days, and two shall be tested at 28 days.

3. Concrete consistency (slump) shall be checked during each pour by testing laboratory in accordance with ASTM C143.

4. Should tests show that concrete is below specified strength, the Contractor shall remove all such concrete. Full cost of removal of inferior concrete, its replacement with concrete of proper specified strength and testing shall be borne by the Contractor.

1.14 CODES AND STANDARDS

A. ACI 301 "Structural Concrete for Building"

B. ACE 305 "Recommended Practice for Hot Weather Concreting"

C. ACI 306 "Recommended Practice for Cold Weather Concreting".

D. ACI 308 "Curing Concrete"

E. ACI 309 "Recommended Practice for Consolidation of Concrete"

F. ACI 318 "Building Code Requirements for Reinforced Concrete".

G. ACI 347 "Recommended Practice for Concrete Formwork".

H. ACI 605 "Recommended Practice for Hot Weather Concreting".

I. ACI 614 "Recommended Practice for Measuring, Mixing, and Placing Concrete".

J. ASTM C31 "Practices for Making and Curing Concrete Test Specimens in the Field".

K. ASTM C33-86 "Specifications for Concrete Aggregate".

L. ASTM C94-89 "Specifications for Ready Mixed Concrete".

M. ASTM C143 "Test Method for Slump Portland Cement Concrete".

N. ASTM C150 "Portland Cement".

O. ASTM C309 “Specifications for Liquid Membrane-forming Compounds for Curing Concrete”.

P. Western Concrete Reinforce Steel Institute (WCRSI) "Manual of Standard Practice".

Q. Where provisions of pertinent codes and standards conflict with this Specification, the more stringent provisions shall govern.

R. California Building Code (CBC), latest edition.

S. Section 90 of the “Standard Specifications of the State of California”, Business and Transportation Agency, Department of Transportation (CSS), latest edition.

PART 2- PRODUCTS

2.1 CONCRETE REINFORCEMENT

A. Reinforcing Bars: Deformed Billet Steel Bars, ASTM A-615, Grade 40 or 60, containing a minimum of 70% total recycled content, clean and free from rust, scale, or coating that will reduce bond.

B. Smooth Dowels for Expansion Joints: ASTM A615, Grade 40 smooth, billet-steel bars, shop painted with iron-oxide zinc-chromate primer.

C. Welded Wire Mesh: ASTM A-185 plain type and uncoated finish.

2.2 CONCRETE

A. Concrete Mix:

1. Ready-mixed concrete in accordance with ASTM C-94 and with aggregates comply with ASTM C-33 and Portland Cement ASTM C-150, Type II.

2. All mixes shall conform to applicable building code requirements listed herein or on the Drawings. All mix designs shall be submitted to the University’s Representative for approval before being used. Mix design shall show proportions of cement, fine and coarse aggregate, and water and graduation of combined aggregates. Calcium chloride shall not be added at any mix.

3. Concrete shall be Class B per University Standards.

4. Cement: All cement shall be Portland cement Type II, and shall be the product of one manufacturer. The temperature of cement delivered to the plant shall not exceed 150 degrees Fahrenheit.

5. Aggregates:

a. Coarse aggregate shall have a minimum cleanliness value of 75.

b. Fine aggregate shall have a minimum of sand equivalent of 75.

c. Any suitable individual grading of coarse aggregates may be used.

6. Water: All water shall be clean and free from deleterious matter.

7. Admixture: No admixture of any type shall be used without prior approval of the University's Representative.

8. Concrete shall be as specified: Class B

a. 28-Day Minimum Strength: 3500 pounds per square inch

b. Concrete slump: Three inches to four inches (five inch maximum for any single truckload.)

c. Air Content: No air entrainment

B. Fly Ash: Flyash: Pozzolanic admixtures, conforming to ASTM C618, Class C, with weight loss of ignition limited to not exceed 3 percent shall be used in mix designs to replace Portland Cement at a minimum rate of 20% up to 35% by weight, unless noted otherwise on drawings.

1. Reference: ACI 211.4R-93.

C. Aggregate Base for On-grade Slabs (standard non pervious and when not adjacent to pervious concrete systems):

1. Description: Class II aggregate base shall be free from organic matter and other deleterious substances, and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base.

2. Grading Requirements:

Percent Passing	Sieve Size
100	1 in.
90-100	3/4 in.
0-10	#4
0-3	#100

3. Quality Requirements:

a.	Minimum "R" value	40
b.	Max. Expansion Pressure; Calif. Test Method No. 301	100 psf
c.	Maximum Plasticity Index:	12
d.	Sand Equivalent	20 min

D. Water: Clean, potable concrete mixing water free from injurious amounts of salts, oils, acids, alkalis, organic materials or other deleterious matter. As available from University. Transport as required.

E. Air Entrainment: ASTM C260.

F. Admixtures: Admixtures containing chlorides are not permitted. All admixtures shall be mixed in accordance with manufacture's written recommendations.

2.3 DETECTABLE WARNING SURFACE

A. Detectable warning surfaces shall be ADA compliant

B. Detectable warning surface shall be Armorcast Wet Set Panel, or approved equal.

1. Color: Truncated dome color and contrast shall be in accordance with the requirements of CBC 11B-705.1.1.3.

2. Size: All truncated dome panels shall be 36" wide. The length shall be according to the Civil drawings.

3. Warranty: The manufacturer guarantees a five-year manufacturer warranty.

2.4 ACCESSORIES

A. Tie Wires: Black annealed, ASTM A-82, minimum 16 gauge.

B. Chains, Bolsters, Bar supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

C. Stirrup Steel: ASTM A-82.

D. Snap Ties: Snap-off metal of fixed length capable of leaving no metal within 1 1/2 in. of surface nor causing fractures, spall or other defects larger than one [1] in. diameter.

E. Expansion Joint Materials:

1. Premolded Joint Filler: ASTM D1751, non-extruding and bituminous type resilient filler, compatible with sealant, and having a "guide strip" removable depth gauge.

2. Joint Sealant: ASTM C290, non-snag sealant "Dynatred" by Pecora Corporation, [214] 278-8158 or "Sonolastic Sealant Two-Part" by Sonneborn, [415] 889-9899 Bay Area or [612] 835-3434, or approved equal.

a. Color shall be from the manufacturer’s full color selection, color submittal to University and consultant for choice and approval.

4. Bond Breaker: Pressure-sensitive tape as recommended by sealant manufacturer to suit application.

5. Premolded Joint Filler: closed cell plastic joint filler, Sonoflex-F by Sonneborn, or equal.

6. Slip Dowels: Spaced at 18” on center.

F. Forms:

1. Steel or wood of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.

2. Use forms that are straight and free of distortions and defects.

3. Use flexible spring forms or laminated boards to form radius bends as required.

G. Form Release Agent: Colorless non-staining, free from oils. Chemical agent shall not impair bonding of paint or other proposed coatings.

H. Form-Facing Materials:

1. All Surfaces: Of sufficient strength to hold concrete properly in place and prevent leakage of water from forms.

2. Exposed Surfaces: A-Matte, Two-step MDO plywood made for forming by Simpson Timber Co., [206] 292-5000 or accepted equal. No wood-textured finish will be permitted on exposed concrete unless specified as such, or approved equal.

I. Steel Headers:

1. Size: 3/16 in. x 4 in. primed and painted steel.

2. Color: Black

3. Stakes: 15” Steel rebar as supplied by header manufacturer

4. Product: Dura Edge by JD Russell Company, Joseph T. Ryerson & Son, Inc., Brighton By-Products Co., or equal.

J. Dampproofing: ASTM C836-81, Fluid-V single component, bitumen-modified, moisture-curing polyurethane "Tremproof 60" by Tremco, [800] 321-7906, or approved equal.

K. Curing Compound: ASTM C309, Type I-D, Class A.

L. Chamfer Strips: Rigid PVC, 1/2 inch x 1/2 inch in maximum possible lengths, by Burke Co., [415] 658-7942, or approved equal.

PART 3- EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that subgrade preparation for concrete paving has been completed prior to commencement of work.

B. Surface Drainage:

1. Report in writing conflicts discovered on the site or prior work done by others, which would prevent positive drainage.

2. Do not permit finished paving surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes. No "birdbaths" or other surface irregularities will be permitted. Properly correct irregularities.

3.2 PREPARATION

A. Templates: Use templates for all anchor plates, bolts, inserts and other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.

B. Piping and Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum. Verify size, length and location of electrical conduit.

C. Exposed Tree Roots: protect roots exposed during excavation with a non-permeable sacrificial material to prevent excessive drying during the placement and curing process.

D. Aggregate Base Course: Compact base course to thicknesses shown on Drawings to 95% relative compaction for areas under non pervious pavements as indication on drawings.

3.3 CONCRETE REINFORCEMENT PLACEMENT

A. Fabricate reinforcement in accordance with ACI-315, providing a minimum concrete cover of three inches or as specified in UBC, latest edition.

B. Place all reinforcement in the exact position shown on the Drawings and secure in position during the placing and compacting of concrete. Wire bars together with No.16 gauge wire with ties at all intersections except where spacing is less than twelve inches in each direction, in which case tie alternate intersections.

C. Place all sleeves, inserts, anchors and embedded items required for adjoining work or for its support prior to concreting. Fill voids in embedded items temporarily with readily removable material to prevent entry of concrete.

D. Give all contractors and subcontractors whose work is related to concrete or supported by it, ample notice and opportunity to introduce and/or furnish embedded items before concrete placement.

E. Verify that concrete reinforcement may be installed in strict accordance with all pertinent codes and regulations, the Shop Drawings and the original design.

F. Verify score joints in sidewalk slabs are constructed at 10-foot maximum intervals.

G. Bending:

1. Fabricate all reinforcement in strict accordance with the reviewed Shop Drawings.

2. Do not use bars with kinks or bends not indicated on the Drawings or on the reviewed Shop Drawings.

3. Do not bend or straighten steel in a manner that will injure the material.

4. Bend all bars cold.

5. Make all bends for other bars, including hooks, around a pin having diameter not less than six times the minimum thickness of the bar for number 8 and smaller and eight times the thickness for number 9 and larger.

H. Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting by concrete blocks, metal chairs or spacer, or by metal hangers.

I. Clearance:

1. Preserve clear space between bars of not less than one time the normal diameter of round bars.

2. In no case let the clear distance be less than 1 inch or less than 1-1/3 times the maximum size of aggregate.

3. Provide the following minimum concrete covering of reinforcement:

4. Concrete below ground deposited against forms: 3 inches.

5. Concrete deposited against earth: 3 inches.

6. Concrete elsewhere: as indicated on Drawings.

J. Splicing:

1. Horizontal bars:

2. Place bars in horizontal members with minimum laps at splices sufficient to develop the strength of the bars. Splice 40 bar diameters minimum.

3. Bars may be wired together at laps.

4. Wherever possible, stagger the splices of adjacent bars.

5. Wire fabric: Make all splices in wire fabric at least 1-1/2 meshes wide.

6. Other splices: Make only those other splices that are indicated on the approved Shop Drawings or specifically approved by University's Representative.

K. Dowels/Anchor Bolts: Place all required steel dowels/anchor bolts and securely anchor them into position before the concrete is placed. Bending the dowels after placement of concrete will not be permitted.

L. Obstruction: In the event conduits, piping, inserts, sleeves, or any other items interfere with placing reinforcement as indicated on the Drawings, or as otherwise required, immediately consult University's Representative and obtain review of new procedure before placing concrete.

3.4 CONCRETE FORMWORK CONSTRUCTION

A. Construct support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete.

B. Contractor assumes full responsibility in the removal of forms. The length of time forms must remain in place depends on the rate of time required for concrete to obtain a proper strength. Remove forms after the concrete is sufficiently hard to prevent damage to concrete.

C. Reuse of Forms:

1. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of surface.

2. Thoroughly clean and properly coat forms before reuse.

D. Circular or curved formwork shall be continuous, complete radii as indicated on Drawings. No straight segments in circular/curved formwork shall be accepted.

3.5 INSTALLATION

A. Notification: Notify the University's Representative at least 48 hours before placing concrete.

B. Placing Concrete:

1. Unless otherwise indicated or required by the Drawings, concrete paving shall be placed on compacted subgrade to thicknesses indicated on the Drawings to 95 percent compaction.

2. Place concrete in accordance with ACI-304 and Section 2605 of the California Building Code. Immediately after depositing, compact concrete thoroughly by mechanical vibration. No vibrating of form is allowed. Mixing shall be continuous, with no interruptions from the time the truck is filled until the time it is emptied. Concrete shall be placed within one and a hours of the time water is first added.

3. Insure anchors, seats, plates, and other items to be cast into concrete are placed, held securely and will not cause hardship in placing concrete.

4. Insure reinforcement, inserts, embedded parts, etc. are not disturbed during concrete placement.

5. Pour concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur, unless otherwise indicated on the Drawings.

6. Lines and Grades: Elevations requiring accurate placement shall be set by a competent instrument man, using a professional type instrument.

7. For all concrete placed on soil, the subgrade shall be wet and compacted prior to placing.

8. Before placing concrete mixing, conveying and finishing equipment, forms and reinforcing shall be well-cleaned. Wet form before placing concrete, unless oiled forms are used.

3.6 CURING AND PROTECTION

A. Beginning immediately after placement, protect concrete from premature drying, from excessively hot or cold temperatures, and from mechanical injury. Maintain concrete with minimal moisture loss at relatively constant temperature for a period necessary for hydration of cement and hardening of concrete. In hot, dry and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation – control material. Apply according to manufacturer’s instruction.

B. As soon as building flat work has hardened sufficiently to prevent injury to finish, apply an approved concrete curing agent in accordance with the manufacturer's recommendation.

C. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than seven (7) days.

D. Excessive cracking as determined by the Design Professional which is aesthetically unacceptable or which will result in premature disintegration of paving shall result in replacement of concrete.

E. Removal of Forms: Remove no sooner than at seven [7] days after each pour.

F. Conform to all applicable requirements for curing and protection of concrete, Sections 90-7 and 90-8 of the Standard Specifications.

G. Spraying: Spray concrete during the curing period as frequently as drying conditions may require.

H. Curing: Cure concrete in accordance with the ACI Manual of Concrete Practice. During curing period, maintain concrete above 70 degrees F. for at least 3 days or above 50 degrees F. for at least 5 days.

I. Damage and Defacement: Protect all concrete work against damage and defacement during subsequent construction operations until final acceptance.

3.7 CLEANING AND PATCHING

A. Removal: Remove all projecting fins, bolts, wire, nails, etc., not necessary for the work, or cut them back 1 in. from the surface and patch in an inconspicuous manner.

B. Snap Ties: Immediately after removal of forms, cut off snap ties extending from the face of concrete to at least 1 in. deep in the concrete. Fill or plug as detailed in Drawings.

C. Voids: Fill holes with a 1:3 cement/sand mortar with the same color as the adjoining concrete. Mix and place the mortar as dry as possible and finish flush with the adjacent surface.

D. Corrective Patching: Correct all defects in concrete work. Chip all voids to a depth of at least 1 in. with the edges perpendicular to the surface and parallel to form markings. Fill all voids, surface irregularities, or honeycombing by patching or rubbing. Ensure that all concrete surfaces so repaired duplicate the appearance of the unpatched work.

E. Finishing: Work finish surface texture as specified below.

3.8 FINISHES

A. Light Broom Finish:

1. Floating: Float surface once it has sufficiently stiffened. Check planeness of surface with a 10 ft. straightedge in all directions. Cut down high spots and fill lows. immediately refloat to a uniform non-directional sandy texture.

2. Obtain by drawing a stiff bristled broom across a floated finish.

3. Direction of brooming to be perpendicular to direction of paving.

3.9 JOINTS

A. Construction Joints:

1. Locate and install joints as indicated on the Drawings so they do not impair strength or appearance of slab.

2. Score joints shall be formed in the fresh concrete using a jointer to cut the groove so that a smooth uniform impression is obtained. All joints shall be struck before and after sandblast.

3. All joints and other edges shall be formed in the fresh concrete using an edging tool to provide a smooth uniform impression.

B. Score Joints:

1. Locate and install joints as indicated on the Drawings so they do not impair strength or appearance of slab.

2. Locate and form joints with ¼" radius edges and 1" to 1-1/4" deep score at the location as shown on the Drawings.

3. All joints and other edges shall be formed in the fresh concrete using an edging tool to provide a smooth uniform impression.

C. Expansion Joints:

1. Locate and install joints as indicated on the Drawings so they do not impair strength or appearance of slab.

2. Expansion joints shall be provided at the location and 40-foot maximum intervals as shown on the plans, and at all locations where concrete paving abuts buildings, curbs or other proposed or existing structures. Install as per detail on the Drawings.

3. All joints and other edges shall be formed in the fresh concrete using an edging tool to provide a smooth uniform impression.

4. Install zip strip as indicated on the Drawings.

5. Sealing of Expansion Joints: After the curing period, strip out all depth gauge strips and carefully clean expansion joints. Fill with joint compound as shown on Drawings. Avoid spilling compound on paved surfaces or overflowing from joint.

6. Protect expansion joints from damage until placement of filler or caulk.

D. Design Finish Delineating Joints:

1. Separation between the smooth surface finishes and the exposed aggregate surface finishes of the concrete slab shall be incorporated using a shallow rake joint with ¼" radius edges as per detail on the Drawings.

3.10 DAMPPROOFING

A. Preparation of Surfaces:

1. Clean all surfaces to be damp-proofed. Remove all dirt, grease, and other foreign matter which might interfere with adhesion and penetration. Allow surfaces to dry thoroughly.

2. Carefully repair all cracks, holes, voids, open areas and other defects in concrete surfaces to be damp-proofed. Use Portland Cement mortar; strike flush and permit to dry.

3. Thoroughly clean all excess mortar from concrete surfaces after drying.

B. Application of Dampproofing Compound:

1. Cover entire retaining surface of backside of walls from top of footing to finished grade with two brush coats of specified damp-proofing. Apply according to manufacturer's current printed instructions.

2. Apply first coat at minimum rate of 80 square feet per gallon of material. Brush into surface thoroughly making sure that coverage is uniform.

3. Allow first coat to dry for 24 hours and apply second coat at minimum rate of 150 square feet per gallon of material. Brush second coat at right angles to first coat to assure thorough coverage of entire surface. Apply damp-proofing in a clean line conforming to finished ground grade.

4. Provide a completed damp-proofing coating which is a continuous, uniform, unbroken, impervious film, free from pinholes and other surface breaks.

3.11 FIELD QUALITY CONTROL

A. Samples: Contractor shall coordinate with the University to select a qualified testing laboratory to take samples for testing during the course of the work as considered necessary.

B. Cost of Testing: As specified in Division 01

C. Rejected Materials: Remove off the site all concrete below specified strength.

D. Cost of Removal and Retesting: As specified in Division 01

E. Defective Work: Remove in its entirety and replace all defective concrete work which after corrective patching, rubbing, etc., fails to duplicate the appearance of unpatched work and/or conform to the standards set forth in these Specifications.

F. Observe formwork continuously while concrete is being placed to see that there are no deviations from desired elevation, alignment, plumbness or camber.

G. If during construction any weakness develops and falsework shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen falsework.

3.12 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the applicable provisions of Division 01, Section 01 74 19 Site Waste Management including, but not limited to:

1. Separate packaging materials by type and place in location designated by the Contractor.

2. Place unused scrap materials in location designated by the Contractor.

END OF 03 32 00- SITEWORK CAST-IN-PLACE CONCRETE

SECTION 26 05 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Table of Contents, Division 26 - Electrical:

SECTION NO.	SECTION TITLE
26 05 00	BASIC ELECTRICAL REQUIREMENTS
26 05 26	GROUNDING AND BONDING
26 05 19	BUILDING WIRE AND CABLE
26 05 43	UNDERGROUND DUCTS AND STRUCTURES
26 24 14	INTEGRATED DISTRIBUTION ASSEMBLIES
26 24 16	PANELBOARDS
26 28 17	OVERCURRENT PROTECTIVE DEVICES
26 50 02	EXTERIOR LIGHTING

B. Work included: This Section includes general administrative and procedural requirements for Division 26. The following administrative and procedural requirements are included in this Section to supplement the requirements specified in Division 1.

1. Quality assurance.
2. Definition of terms.
3. Submittals.
4. Coordination.
5. Record documents.
6. Operation and maintenance manuals.
7. Project management and coordination services.
8. Excavation.
9. Rough-in.

10. Electrical installation.

11. Cutting, patching, painting and sealing.

12. Field quality control.

13. Project closeout.

14. Interface/Responsibility Matrix.

C. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.

1. General and supplementary conditions: Drawings and general provisions of Contract and Division 1 of the Specifications, apply to all Division 26 Sections.

2. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, lighting pole foundations, etc. Refer to Division 31, Earthwork.

3. Concrete work: Include forming, steel bar reinforcing, cast-in- place concrete, finishing and grouting as required for under ground conduit encasement, light pole foundations, pull box slabs, vaults, housekeeping pads, etc. Refer to Division 3, Concrete.

4. Miscellaneous metal work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panelboards, distribution boards, switchboards, motor control centers, etc. Refer to Division 5, Miscellaneous Metals.

5. Miscellaneous lumber and framing work: Include wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment. Refer to Division 6, Rough Carpentry.

6. Moisture protection and smoke barrier penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vaportight. Refer to Division 7, Thermal and Moisture Protection.

7. Access panels and doors: Required in walls, ceilings, and floors to provide access to electrical devices and equipment. Refer to Division 8, Access Doors also, Division 5, Metals.

8. Painting: Include surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, etc. where indicated as field painted in this Division. Use campus standard color RAL 7023 SM GL Tribo.

D. Equipment specified under another Division requiring electrical connections specified under this Division, includes but is not limited to:

1. Emergency blue light phone.

1.2 QUALITY ASSURANCE

A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.

B. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred authority for reducing the quality, requirements or extent of the Drawings and Specifications. The contract documents address the minimum requirements for construction.

C. Work shall be performed in accordance with all applicable requirements of the listed edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. California Code of Regulations (CCR) Title 24, California Building Standards Code Part 2, Basic Building Regulations and Part 3, California Electrical Code (CEC), latest edition.

2. California Building Code (CBC), latest edition.

3. California Fire Code (CFC), latest edition.

4. California Mechanical Code (CMC), latest edition.

5. California Plumbing Code (CPC), latest edition.

D. Standards: Equipment and materials specified under this Division shall conform to the following standards where applicable:

ACI	American Concrete Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
CBM	Certified Ballast Manufacturers
ETL	Electrical Testing Laboratories
FS	Federal Specification

IEEE	Institute of Electrical and Electronics Engineers, Inc.
IPCEA	Insulated Power Cable Engineer Association
NEMA	National Electrical Manufacturer's Association
UL	Underwriters' Laboratories

E. All base material shall be ASTM and/or ANSI standards.

F. All electrical apparatus furnished under this Section shall conform to NEMA standards and the CEC and bear the UL label where such label is applicable.

G. Certify that each welder performing work has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.3 DEFINITION OF TERMS

A. The following list of terms as used in the Division 16 documents shall be defined as follows:

1. "Provide": Shall mean furnish, install and connect unless otherwise indicated.

2. "Furnish": Shall mean purchase and deliver to project site.

3. "Install": Shall mean to physically install the items in-place.

4. “Equal”: Shall be of the same quality, appearance and utility to that specified, as determined by the University’s Representative. Contractor bears the burden of proof of equality.

5. "Connect": Shall mean make final electrical connections for a complete operating piece of equipment.

6. "As directed": Shall be as directed by the University’s Representative.

7. “As required”: Shall be as required by applicable code requirements, good building practice, the conditions prevailing, the Bid Documents, the University, or the University’s Representative.

8. “As selected”: Shall be as selected by the University’s Representative.

9. "Utility Companies": Shall mean the company providing electrical, telephone, or cable television services to the project.

1.4 SUBMITTALS

A. Format: Furnish submittal data neatly bound in an 8-1/2" x 11" folder or binder for each Specification Section with a table of contents listing materials by Section and paragraph number.

B. Submittals shall consist of detailed shop drawings, specifications, block wiring diagrams, "catalog cuts" and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, and material finish. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories which are included and those which are excluded. Furnish quantities of each submittal as noted in Division 1.

C. Each submittal shall be labeled with the Specification Section Number and shall be accompanied by a cover letter or shall bear a stamp stating that the submittal has been thoroughly reviewed by the Contractor and is in full compliance with the requirements of the Contract Documents. Cover letters shall list in full the items and data submitted. Failure to comply with this requirement shall constitute grounds for rejection of data.

D. The Contractor shall submit detailed drawings of all electrical equipment rooms and closets if the proposed installation layout differs from the construction documents. Physical size of electrical equipment shown on the drawings shall match those of the electrical equipment that is being submitted for review, i.e.: switchboards, panelboards, transformers, control panels, etc. Minimum scale: 1/4" = 1'- 0". Revised electrical equipment layouts must be reviewed prior to release of order for equipment and prior to installation.

E. As part of the equipment submittals, the manufacturer shall provide anchorage calculations for floor and wall mounted electrical equipment so that it shall remain attached to the mounting surface after experiencing forces in conformance with CCR, Title 24, Table 23P, Part II and with Section 2312 "Earthquake Regulations" of the "Uniform Building Code" for Seismic Zone 4 Area, Importance Factor of 1.25. Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

F. The manufacturer shall recommend the method of anchoring the equipment to the mounting surface and shall provide the Contractor with the assembly dimensions, weights and approximate centers of gravity.

G. All resubmittals shall include a cover letter that lists the action taken and revisions made to each drawing and equipment data sheet in response to Submittal Review Comments. Resubmittal packages will not be reviewed unless accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.

H. Substitutions:

1. All requests for substitutions shall conform to the general requirements and procedure outlined in Division 1.

2. Where items are noted as "or equal," a product of equal design, construction and performance will be considered. Contractor must submit all pertinent test data, catalog cuts and product information required substantiating that the product is in fact equal to that specified. Only one substitution will be considered for each product specified.

3. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish

standards of quality, utility and appearance. Materials, processes or equipment, which, in the opinion of the University's Representative, are equal in quality, utility and appearance, will be approved as substitutions to that specified.

4. Whenever any material, process or equipment is specified in accordance with a Federal specification, ASTM standard, ANSI specification, UL listing or other association standard, the Contractor shall present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the University's Representative, support test data to substantiate compliance shall be submitted by the Contractor at no additional cost.

5. Substitutions shall be equal, in the opinion of the University's Representative, to the specified product. The burden of proof of such shall rest with the Contractor. When the University's Representative, in writing, accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted article or material to be equal to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from any provisions of the Specifications.

6. The Contractor shall be responsible for all expenses in connection with the substitution materials, processes and equipment, including the effect of his substitution on him, his subcontractor's or other Contractor's work. No substitution of material, processes or equipment shall be permitted without written authorization of the University's Representative. Any assumptions on the acceptability of a proposed substitution prior to acceptance by the University's Representative are at the sole risk of the Contractor.

1.5 COORDINATION

A. Discrepancies:

1. In the event of discrepancies within the Contract Documents, the University's Representative shall be so notified, within sufficient time, as delineated in Division 1, prior to the Bid Opening to allow the issuance of an Addendum.

2. If, in the event that time does not permit notification or clarification of discrepancies prior to the Bid Opening, the following shall apply: The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Contractor's Bid. No additional allowances will be made because of errors, ambiguities, or omissions that reasonably should have been discovered during the preparation of the Bid.

B. Job conditions:

1. Examination of site: The Contractor shall visit the site and thoroughly review the locale, working conditions, conflicting utilities and the conditions in which the electrical work will take place. Verify all existing conditions in the field. No allowances will be made subsequently for any costs that may be incurred because of any error or omission due to failure to examine the site and to notify the University's Representative of any discrepancies between Drawings and Specifications and actual site conditions.

2. Protection: Keep conduits, junction boxes, outlet boxes and other openings closed to prevent entry of foreign matter. Cover fixtures, equipment, devices, and apparatus and protect them against dirt, paint, water, chemical or mechanical damage, before and during construction period. Prior to final acceptance, restore to original condition any fixture, apparatus or equipment damaged including restoration of damaged factory applied painted finishes. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.

3. Supervision: Contractor shall personally or through an authorized and competent representative constantly supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the project throughout the project duration.

C. Preparation:

1. Drawings:

a. Layout: General layout shown on the Drawings shall be followed except where other work may conflict with the Drawings.

b. Accuracy: Drawings for the Work under this Section are essentially diagrammatic within the constraints of the symbology applied.

1.6 RECORD DOCUMENTS

A. Provide project record drawings as described herein:

1. Drawings shall fully represent installed conditions including actual locations of outlets, true panelboard connections following phase balancing routines, correct conduit and wire sizing as well as routing, revised fixture schedule listing manufacturers and products actually installed, and revised panel schedules. Contractor shall record all changes in the work during the course of construction on blue or black line prints. These prints shall be made subject of monthly review by the University's Representative to ascertain that they are current. If not current monthly payments may be withheld.

2. Record drawings shall be the transfer of information on these prints to the construction documents via computer aided drafting (CAD) process. A set of CAD files of the electrical documents will be provided to the contractor in either Autocad Release 14 or later format.

3. Record drawing submissions shall be provided to the University's Representative to review upon the completion of the following phases of work:

   a. All underground installation.

   b. Building electrical rough-in.

   c. Final electrical installation.

4. A single set of half size prints of the record drawings shall be submitted for review. Upon receipt of the review comments, corrections shall be made and the contractor shall provide the following:

   a. Two sets of full size prints.

   b. Four sets of half size prints.

   c. One set of full size reproducibles.

   d. DXF files of drawings.

B. Panel schedules:

1. Typewritten panel schedules shall be provided for panelboards indicating the loads served and the correct branch circuit number. Schedules shall be prepared on forms provided by the manufacturer and inserted in the pocket of the inner door of each panelboard. See Section 26 24 16: Panelboards for requirements.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Prior to project closeout, furnish to the University's Representative six (6) hard back 3-ring binders containing all bulletins, operation and maintenance instructions, part lists, service telephone numbers and other pertinent information as noted in each Section for equipment furnished under Division 26. Binders shall be indexed into Division Sections and labeled for easy reference. Bulletins containing more information than the equipment concerned shall be properly stripped and assembled.

B. O&M manuals shall be in both hard copy format and electronic format (pdf or html). Electronic files must have searchable text for ease in locating specific information, i.e. no scanning of paper documents. O&M's shall include submittal information so that the specific details and applications of each device for this project are available.

1.8 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Overview: Contractor shall provide a project manager/engineer for the duration of the project to coordinate the work specified under Division 26 with all other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.

B. Review of shop drawings prepared by other subcontractors:

1. Obtain copies of all shop drawings for equipment provided by others that require electrical service connections or interface with work specified under Division 26.

2. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 26 contract documents. Document any discrepancy or deviation as follows:

   a. Prepare memo summarizing the discrepancy.

   b. Provide a copy of the specific shop drawing, indicating via cloud, the discrepancy.

3. Prepare and maintain a shop drawing review log indicating the following information:

   a. Shop drawing number and brief description of the system/material.

   b. Date of your review.

   c. Indication if follow-up coordination is required.

C. Request for information (RFI):

1. Thoroughly review the contract documents prior to the preparation and submission of an RFI. If an RFI is submitted, attach 8 1/2" x 11" copies of all relevant documents to clarify the issue.

2. Prepare and maintain an RFI log indicating the following information:

   a. RFI number and brief summary of the issue.

   b. Date of issuance and receipt of response.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 EXCAVATION

A. General: Cutting and digging shall be under the direct supervision of the General Contractor, and included as necessary for the Work of this Section.

B. Trenching: Excavate trenches for electrical installation as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearances on both side of raceways and equipment.

2. Excavate trenches to depth indicated or required.

3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.

4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.

C. Backfilling: Place soil materials in layers to required subgrade elevations for each area classification, using materials and methods specified in Division31, Earthwork.

3.2 ROUGH-IN

A. Contractor shall verify lines, levels and dimensions shown on the Drawings and shall be responsible for the accuracy of the setting out of Work and for its strict conformance with existing conditions at the site.

B. Verify final locations for rough-ins with field measurements and with the requirements for the actual equipment to be connected.

C. Refer to equipment specification in Divisions 3 through 28 for rough-in requirements.

3.3 ELECTRICAL INSTALLATION

A. Preparation, sequencing, handling and installation shall be in accordance with manufacturer's written instructions and technical data particular to the product specified and/or accepted equal except as otherwise specified. Comply with the following requirements:

1. Shop drawings prepared by manufacturer.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting height is not detailed or dimensioned, contact the University’s Representative for direction prior to proceeding with rough-in.

7. Coordinate connection of electrical systems with exterior underground site utilities and services. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to

arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the University's Representative.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

11. Coordinate electrical systems, equipment, and materials installations with other building components.

12. Provide access panel or doors where devices or equipment are concealed behind finished surfaces. Furnish and install access doors per the requirements specified under Division 8.

13. Install systems, materials, and equipment giving right-of-way priority to other systems that are required to maintain a specified slope.

14. Conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.

3.4 CUTTING, PATCHING, PAINTING AND SEALING

A. Structural members shall in no case be drilled, bored or notched in such a manner that will impair their structural value. Cutting of holes, if required, shall be done with core drill and only with the approval of the University's Representative.

B. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

C. Application of joint sealers:

1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

2. Installation of fire-stopping sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops and fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.5 FIELD QUALITY CONTROL

A. General: Perform tests to prove installation is in accordance with contract requirements. Perform tests in presence of the University's Representative and furnish test equipment, facilities and technical personnel required to perform tests. Tests shall be conducted during the construction period and at completion to determine conformity with applicable codes and with these Specifications.

B. Tests: In addition to specific system test described elsewhere, tests shall include:

1. Insulation resistance: Perform 1000-volt DC tests for one minute on all equipment rated 300 volts and higher, feeder and branch circuit conductors, including the neutral. Make a typed record of all readings to be included in the maintenance instructions. Repair or replace circuits showing less than 10 megohms resistance to ground.

2. Circuit continuity: Test all feeder and branch circuits for continuity. Test all neutrals for improper grounds.

3. Equipment operations: Test motors for correct operation and rotation.

4. Lighting control circuits: Test lighting circuits for correct operation through their control devices.

5. Circuit numbering verification: Select on a random basis various circuit breakers in the panelboards and cycle them on and off to verify compliance of the typed panel directories with actual field wiring.

C. Product failure: Any products which fail during the tests or are ruled unsatisfactory by the University's Representative shall be replaced, repaired or corrected as prescribed by the University's Representative at the expense of the Contractor. Tests shall be performed after repairs, replacements or corrections until satisfactory performance is demonstrated.

D. Miscellaneous: Include all test results in the maintenance manual. Cost, if any, for all tests shall be paid by the Contractor.

E. Cleaning: After other work such as sanding, painting, etc. has been completed, clean lighting fixtures, panelboards, switchboards and other electrical equipment to remove dust, dirt, grease or other marks. Leave work in clean condition.

F. Voltage check:

1. At completion of job, check voltage at several points of utilization on the system that has been installed under this Contract. During test, energize all installed loads.

2. Adjust taps on transformers to give proper voltage, which is 118 to 122 volts for 120 volt nominal systems and proportionately equivalent for higher voltage systems. If proper voltage cannot be obtained, inform the University’s Representative and the serving Utility Company.

3.6 PROJECT CLOSEOUT

A. Training: At the time of completion, a period of not less than 8 hours shall be allotted by the Contractor for instruction of building operating and maintenance personnel in the use of all systems. This 8 hours training is in addition to any instruction time called out in the Specifications for specific systems. All personnel shall be instructed at one time, the Contractor making all necessary arrangements with manufacturer's representative. The equipment manufacturer shall be requested to provide product literature and application guides for the users' reference. Costs, if any, for the above services shall be paid by the Contractor.

B. Special tools: Provide one of each tool required for proper operation and maintenance of the equipment provided under this Section. All tools shall be delivered to the University's Representative at the Project completion.

C. Keying: Provide two keys for each lock furnished under this Section and turn over to University's Representative.

END OF SECTION 26 05 00- Basic Electrical Requirements

SECTION 26 05 19

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Building wire.

2. Wiring connections and terminations.

B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. Underwriters Laboratories, Inc. (UL):

UL 83; Thermoplastic-Insulated Wires and Cables.

UL 486A; Wire Connectors and Soldering Lugs for use with Copper Conductors.

UL 486C; Splicing Wire Connectors.

UL 493; Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables.

UL 854; Service - Entrance Cables.

2. National Electrical Manufacturer Association (NEMA):

NEMA WC-5; Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

NEMA WC-7; Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. Institute of Electrical and Electronic Engineers (IEEE):

IEEE 82; Test Procedure for Impulse Voltage Tests on Insulated Conductors.

1.3 SUBMITTALS

A. Submit in accordance with the requirements of Section 16010: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Only products and applications listed in this Section may be used on the project unless otherwise submitted.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equal Products by the following manufacturers will be considered provided that all features of the specified product are provided:

1. Building wire:

a. America Insulated Wire Corp.

b. Rome Cable.

c. Southwire Company.

d. Or equal.

2. Wiring connectors and terminations:

a. 3M Company.

b. Ideal.

c. Blackburn-Holub.

d. Burndy.

e. Thomas & Betts Corp.

f. Beau Barrier.

g. Or equal.

B. Substitutions: Under provisions of Section 26 05 00: Basic Electrical Requirements.

2.2 BUILDING WIRE

A. Conductor material:

1. Provide annealed copper for all wire, conductor, and cable, unless otherwise indicated.

2. All wiring shall be stranded type conductors, except that fire alarm wiring shall be solid conductors.

B. Insulation material:

1. All insulated wire, conductor, and cable shall be 600 volt rated unless otherwise noted on the drawings.

2. Thermoplastic-insulated building wire: NEMA WC 5.

3. Rubber-insulated building wire: NEMA WC 3.

4. Feeders and branch circuits larger than #6 AWG: Type THW, XHHW, or dual rated THHN/THWN.

5. Feeders and branch circuits #6 AWG and smaller: Type TW, THW, XHHW, or dual rated THHN/THWN.

6. Control Circuits: Type THW, or dual rated THHN/THWN.

7. Identify system conductors as to voltage and phase connections by means of color-impregnated insulation.

2.3 WIRING CONNECTIONS AND TERMINATIONS

A. Bolted pressure connectors: Provide wide range-taking connectors with cast bronze compression bolts, designed for parallel taps, tees, crosses or end-to-end connections.

B. Electrical spring wire connectors:

1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-section steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.

2. Self-striping pigtail and tap U-contact connectors shall not be used.

3. The poke-in type “Wago” connectors are not acceptable.

C. Compression type terminating lugs:

1. Provide tin-plated copper high-compression type lugs for installation with hand or hydraulically operated circumference-crimping tools and dies as stipulated by the lug manufacturer or as indicated on drawings. Notch or single point type crimping is NOT acceptable.

2. Two hole, long barrel lugs shall be provided for size (4/0) and larger wire where terminated to bus bars. Use minimum of three crimps per lug, on sizes where possible.

D. Splicing and insulating tape: Provide black, ultraviolet proof, self-extinguishing, 7 mil thick vinyl general purpose electrical tape with a dielectric strength of 10,000 volts suitable for temperatures from minus 18 degrees C to 105 degrees C. Provide Scotch 33+, Manville or equal.

E. Insulating putty:

1. Provide pads or rolls of non-corrosive, self-fusing, one-eighth inch thick rubber putty with PVC backing sheet. Scotch vinyl mastic pads and roll or equal.

2. Use putty suitable for temperatures from minus 17.8 degrees C to 37.8 degrees C with a dielectric strength of 570-volts/mil minimum.

F. Insulating resin:

1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. Scotchcast 4 or equal for wet or underground vaults, boxes, etc. splices or terminations.

2. Use resin with a set up time of approximately 30 minutes at 21.1 degrees C and with thermal and dielectric properties equal to the insulating properties of the cables immersed in the resin.

G. Terminal strips:

1. Provide box type terminal strips in the required quantity plus 25% spare. Install in continuous rows in terminal cabinets.

2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.

3. Identify all terminals with numbering sequence being used for a particular system.

H. Crimp type connectors:

1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support

2. Fasten crimp type connectors or terminals using a crimping tool recommended by the connector manufacturer.

3. Provide insulated overlap splices with tinned seamless electrolytic copper barrel with funnel wire entry and insulation support.

4. Provide insulated butt splices with tinned seamless electrolytic copper barrel with center stop, funnel wire entry and insulation support.

I. Cable ties: Provide harnessing and point-to-point wire bundling with nylon cable ties. All cable ties shall be installed using tool supplied by manufacturer of ties.

J. Wire lubricating compound:

1. UL listed for the wire insulation and conduit type, and shall not harden or become adhesive.

2. Shall not be used on wire for isolated type electrical power systems.

K. Bolt termination hardware:

1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE grade 5; or silicon bronze alloy ASTM B-9954 Type B.

2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.

3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, confirming to ANSI B27.2. SAE or narrow series shall not be used.

4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.

5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:

a. 1/4" bolt - 125 amps

b. 5/16" bolt - 175 amps

c. 3/8" bolt - 225 amps

d. 1/2" bolt - 300 amps

e. 5/8" bolt - 375 amps

f. 3/4" bolt - 450 amps

PART 3 EXECUTION

3.1 EXAMINATION

A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 APPLICATION

A. All wire, conductor, and cable with their respective connectors, fittings and supports shall be UL listed for the installed application and ambient condition.

B. Feeders and branch circuits in wet locations shall be rated 75 degrees C.

C. Feeders and branch circuits in dry locations shall be rated 90 degrees C.

D. Minimum conductor size:

1. Provide minimum AWG #12 for all power and lighting branch circuits.

2. Provide minimum AWG #14 for all line voltage signal and control wiring unless otherwise indicated.

E. Color coding:

1. For 120/208 volt, 3 phase, 4 wire systems:

a. Phase A - Black

b. Phase B - Red

c. Phase C - Blue

d. Neutral - White

e. Ground – Green

2. For 277/480 volt, 3 phase, 4 wire systems:

a. Phase A - Brown

b. Phase B - Orange

c. Phase C - Yellow

d. Neutral - Gray

e. Ground - Green

3. Switch leg individually installed shall be the same color as the branch circuit to which they are connected, unless otherwise noted.

4. Travelers for 3-way and 4-way switches shall be a distinct color and pulled with the circuit switch leg or neutral.

3.3 WIRING METHODS

A. Install wires and cables in accordance with manufacturer's written instructions, as shown on drawings and as specified herein.

B. Install all single conductors in raceway system, unless otherwise noted.

C. Parallel circuit conductors and terminations shall be equal in length and identical in all ways.

D. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than #10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

E. For 20 amp power and lighting branch circuits containing no more than four (4) current carrying conductors (phases and neutrals), use #10 AWG conductor for 120/208 volt circuits located outside a 75 foot radius of panel source, and for 277 volt branch circuits located outside a 200 foot radius of panel source, unless otherwise noted.

F. For 20 amp power and lighting branch circuits containing no more than eight (8) current carrying conductors (phases and neutrals), use #10 AWG conductors for 120/208 volt circuits located outside a 65 foot radius of panel source and for 277/480 volt circuits located outside a 150 foot radius of panel source.

G. Provide #10 AWG pig tails on all 20A and 30A wiring devices served by #8 AWG conductors and larger.

H. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes. Group and bundle with tie wrap each neutral with it's associated phase conductor where more then one neutral is present in a conduit.

I. Install cable supports for all vertical feeders in accordance with the CEC Article 300. Provide split wedge type fittings, which firmly clamp each individual cable and tighten due to cable weight.

J. Neatly form, train, and tie the cables in individual circuits. For panelboards, cabinets, wireways, switches, and equipment assemblies.

K. Provide UL-listed factory-fabricated, solderless metal connectors of size, ampacity rating, material, type and class for applications and for services indicated. Use connectors with temperature ratings equal to or greater than the wires that are being terminated.

L. Stranded wire shall be terminated using fitting, lugs or devices listed for the application. However, in no case shall stranded wire be terminated solely by wrapping it around a screw or bolt.

M. Flexible cords and cables supplied, as part of a pre-manufacturer fixture or unit assembly shall be installed according to manufacturers published installation instructions.

3.4 WIRING INSTALLATION IN RACEWAYS

A. 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. Pull all conductors into a raceway at the same time. Exercise care in pulling conductors so that insulation is not damaged. Use UL listed, non-petroleum base and insulating type pulling compound as needed.

B. Completely mandrel all underground or concrete encased conduits prior to installing conductors.

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

D. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors of size smaller than AWG #1.

E. Wire pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.

2. Use rope made of nonmetallic material for pulling feeders.

3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors.

4. Pull in together multiple conductors or cables in a single conduit.

F. Install and test all cables in accordance with manufacturer's instructions and warranty.

3.5 WIRE SPLICES, JOINTS, AND TERMINATION

A. Join and terminate wire, conductors, and cables in accordance with UL 486A, C, CEC and manufacturer's instructions.

B. Thoroughly clean wires before installing lugs and connectors.

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

D. Splices and terminations shall be made mechanically and electrically secure.

E. Where it's determined that unsatisfactory splice or terminations have been installed, remove the devices and reinstall to the satisfaction of the University's Representative, at no addition cost.

F. Terminate wires in Terminal Cabinets, relay and contactor panels, etc. using terminal strip connectors.

G. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere in the panel or cabinet.

H. Install cable ties and maintain harnessing.

I. Encapsulate splices in exterior outlets, pullboxes and junction boxes using specified insulating resin kits. Make all splices watertight for exterior equipment and equipment in pump rooms.

J. Make up all splices and taps in accessible junction or outlet boxes with connectors as specified herein. Pigtails and taps shall be the same color as the feed conductor. Form conductor prior to cutting and provide at least six (6) inches of tail and neatly packed in box after splice is made up.

K. Branch circuits (#10 AWG and smaller):

1. Connectors: Solderless, screw-on, reusable spring pressure cable type, 600 volt, 105-degree C. with integral insulation, approved for copper conductors.

2. The integral insulator shall have a skirt to completely cover the stripped wires.

3. The number, size, and combination of conductors as listed on the manufacturers packaging shall be strictly complied with.

L. Feeder circuits: (#6 to 750 MCM)

1. Join or tap conductors from #6 AWG to 750 MCM using bolted pressure connectors or insulate mechanical compression (hi-press) taps with pre-molded, snap-on insulating boots or specified conformable insulating pad and over wrapped with two half-lapped layers of vinyl insulating tape starting and ending at the middle of the joint.

2. Terminate conductors from size #6 AWG to 750 MCM copper using bolted pressure or mechanical compression lugs in accordance with manufacturer recommendation or as specified elsewhere.

3. Field installed compression connectors for cable sizes 250 MCM and larger shall have not less than two clamping elements or compression indents per wire.

4. Insulate splices and joints with materials approved for the particular use, location, voltage and temperature. Insulate with not less than that of the conductor level that is being joined.

M. Termination hardware assemblies:

1. AL/CU lugs connected to aluminum plated or copper buss, shall be secured using a steel bolt, flat washer (two per bolt), Belleville washer, and nut.

2. Copper lugs connected to copper bus, shall be secured using silicon bronze alloy bolt, flat washer (two per bolt), Belleville washer, and nut.

3. The crown of Belleville washers shall be under the nut.

4. Bolt assemblies shall be torque to manufacturer recommendation. Where manufacture recommendation are not obtainable, the following values shall be used:

a. 1/4" - 20 bolt at 80-inch pounds torque.

b. 5/16" - 18 bolt at 180-inch pounds torque.

c. 3/8" - 16 bolt at 20-foot pounds torque.

d. 1/2" - 13 bolt at 40-foot pounds torque.

e. 5/8" - 11 bolt at 55-foot pounds torque.

f. 3/4" - 10 bolt at 158-foot pounds torque.

3.6 IDENTIFICATION

A. Refer to Section 26 05 54: Electrical Identification for additional requirements.

B. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. Where more than two conductors run through a single outlet, mark each conductor with the corresponding circuit number.

C. Color code conductors size #8 and larger using specified phase color markers and identification tags.

D. Provide all terminal strips with each individual terminal identified using specified vinyl markers.

E. In manholes, pullboxes and handholes, provide tags of the embossed brass type, and also show the cable type and voltage rating. Attach the tags to the cables with slip-free plastic cable lacing units.

3.7 FIELD QUALITY CONTROL

A. Independent testing: Electrical contractor shall arrange and pay for the services of an independent testing agency to perform all quality control electrical testing required herein.

B. Prefunctional testing:

1. Visual and Mechanical Inspection:

a. Inspect wires and cables for physical damage and proper connections.

b. Insure wire and cable identification has been installed as specified herein.

2. Electrical testing:

a. Contractor shall perform feeder and branch circuit insulation test after installation and prior to connection to utilization devices such as fixtures, motors, or appliances.

b. Tests shall be performed by 600 VDC megger for a continuous 10 seconds. Test conductors phase-to-phase and phase-to-ground. Conductors shall test free from short-circuit and ground faults.

c. Contractor shall furnish instruments, materials, and labor for these tests.

d. Torque test conductor connections and terminations for conformance with specifications.

3. Furnish test results in typewritten report form for review and inclusion in the operation and maintenance manuals.

END OF SECTION 26 05 19 – Building Wire and Cable

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Power system grounding.

2. Telecommunication system grounding.

3. Electrical equipment and raceway grounding and bonding.

B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. Underwriters Laboratories, Inc. (UL):

a. UL 467; Grounding and Bonding Equipment.

2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

a. IEEE No. 142; Recommended Practice for Grounding of industrial and Commercial Power Systems.

1.3 SYSTEM DESCRIPTION

A. Ground the electrical service system neutral at service entrance equipment as described herein and indicated on drawings.

B. Ground each separately derived system neutral as described herein and indicated on drawings.

C. Provide telecommunications system grounding conductor as described herein and indicate on drawings.

D. Except as otherwise indicated, the complete electrical installation including the neutral conductor, metallic conduits and raceways, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified.

E. Provide a safety ground grid and/or mat beneath all electrical switchgear operating at 1000 volts and above. Grid/mat shall be poured in the concrete floor slab and constructed as specified herein.

F. Resistance:

1. Resistance from the main switchboard ground bus through the ground electrode to earth shall not exceed 5 OHMS unless otherwise noted.

2. Resistance from the farthest panelboard, switchboard, etc. ground bus through the ground electrode to earth shall not exceed 20 OHMS

1.4 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Only products and applications listed in this Section may be used on the project unless otherwise submitted.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

1. Ground Rods:

a. Weaver.

b. Erico "Cadweld" Products, Inc.

c. ITT Blackburn.

d. Or equal.

2. Ground Wells:

a. Christy Concrete Products, Inc.

b. Forni Corp.

c. Or equal.

3. Ground Bushings, Connectors, Jumpers and Bus:

a. O-Z/Gedney.

b. Thomas & Betts Corp.

c. Or equal.

B. Substitutions: Under provisions of Section 260500 Basic Electrical Requirements.

2.2 GROUND CONDUCTORS

A. Refer to Specification Section 26 05 19: Building Wire and Cable for conductor requirements.

B. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green. Where continuous color-coded conductors are not commercially available, provide a minimum 4" long color band with green, non-aging, plastic tape in accordance with CEC.

C. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.

2.3 DRIVEN (GROUND) RODS

A. Copper clad steel, minimum 3/4-inch diameter by 10 feet long, unless otherwise noted.

2.4 GROUND WELL BOXES FOR GROUND RODS

A. Precast concrete box nominal 9" throat diameter x 14" deep with light duty concrete cover for non-traffic areas or steel plate for traffic areas. Cover shall be embossed or engraved with "GROUND ROD".

2.5 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.6 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.

1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.

2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Thoroughly examine site conditions for acceptance of grounding system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 INSTALLATION

A. Grounding electrodes:

1. Supplementary grounding electrode (ground ring, grid, and driven rods): Provide, as shown on the drawings, driven ground rod(s) installed in listed ground well box(s) and filled with gravel after connection is made. Interconnect ground rod with structural steel and adjacent rods with minimum #4 AWG bare copper conductor. Ground rod shall not be less than 10 foot from any other electrode of another electrical system or from adjacent ground rod(s).

B. Grounding electrode conductor: Provide grounding electrode conductor as indicated on the drawings or sized per CEC Table 250-94, whichever is greater.

C. Equipment bonding/grounding:

1. Provide an insulated copper ground conductor sized in accordance with CEC requirements in all 120VAC through 600 VAC feeder and branch circuit distribution conduits and cables.

2. Provide a separate grounding bus at panelboards. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35 volts above ground.

3. Conduit terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.

4. Provide internal ground wire in flexible conduit connected at each end via grounding bushing.

5. Provide external ground wire wrapped around flexible conduit and terminate to connectors designed for the purpose.

3.3 FIELD QUALITY CONTROL

A. Independent Testing: Arrange and pay for the services of an independent testing agency to perform all quality control electrical testing required herein.

B. Prefunctional testing:

1. Provide testing agency with contract documents for their review prior to the commencement of ground testing.

2. Visual and mechanical inspection:

a. The testing agency shall inspect the grounding electrode and connections prior to concrete encasement, burial, or concealment.

b. Check tightness and welds of all ground conductor terminations.

c. Verify installation complies with the intent of the contract documents

3. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required complying with resistance limits specified under this Section of the Specification.

4. Typewritten records of measured resistance values shall be submitted for review and included with the operation and maintenance manual furnished to the University at the time of project closeout.

END OF SECTION 26 05 26 – Grounding and Bonding

SECTION 26 05 43

UNDERGROUND DUCTS AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Underground conduits.

2. Handhole and pullboxes.

3. Excavation, trenching and backfill.

B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1. Division 3 - Cast-in-place concrete: Protective envelope for ducts.

2. Division 31 - Earthwork: General requirements for Excavation and Backfill and related items for ducts, manholes, pullboxes and handholes.

1.2 REFERENCES

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

1. Federal Specifications (FS):

FS W-C-1094A; Conduit and Conduit Fittings Plastic, Rigid.

2. American National Standards Institute, Inc. (ANSI):

3. Underwriters Laboratories, Inc. (UL):

UL 651; Schedule 40 and 80 Rigid PVC Conduit.

4. National Electrical Manufacturer Association (NEMA):

NEMA TC 2; Electrical Plastic Tubing and Conduit.

NEMA TC 3; PVC Fittings for use with Rigid PVC Conduit.

5. American Concrete Institute (ACI):

ACI 318; Building Code Requirements for Reinforced Concrete.

1.3 DEFINITIONS

A. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground embedded in earth or concrete.

B. Duct bank: Two or more conduits or other raceway installed underground in same trench or concrete envelope.

C. Handhole: An underground junction box in a duct or duct bank.

1.4 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Shop Drawings showing details and design calculations for precast handholes, including reinforced steel.

4. Submit Manufacturer's installation instructions.

5. Complete bill of material listing all components.

1.5 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.

B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted and approved.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

1. Underground precast concrete utility structures:

a. Christy Concrete Products, Inc.

2. Conduits, ducts and fittings:

a. Carlon Electrical Products.

b. Occidental Coating Company (OCAL).

c. PW Pipe Company.

B. Substitution: Under provisions of Section 26 05 00 Basic Electrical Requirements.

2.2 CONDUIT AND DUCT

A. PVC insulated galvanized rigid steel conduit (PVC GRS):

1. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 20 or 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.

2. Fittings: Conduit couplings and connectors shall be steel or malleable iron as required with factory PVC coating and insulated jacket equivalent to that of the coated material.

B. Rigid non-metallic conduit (PVC):

1. Conduit:

a. Rigid polyvinylchloride, schedule 40 or 80 conforming to NEMA TC2 and UL 651. UL listed for exposed and direct-burial applications and for 90 degrees C conductor insulation. Conduit shall include an integral bell fitting at one end.

2. Fittings: Couplings, adaptors, transition fittings, bell ends, etc., shall be molded PVC, slip on and solvent weld type. Schedule 40 or 80 conforming to NEMA TC 3.

3. Factory elbows: Minimum radius bends shall be 36 inches.

C. Duct supports: Rigid PVC spacers selected to provide minimum duct spacing and concrete cover depths, while supporting ducts during concrete pour.

D. Duct sealing compound: Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 degree F, withstands temperature of 300 degrees F without slump and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, cable sheaths and jackets, etc.

2.3 PULLBOXES AND HANDHOLES

A. Construction: High densities precast reinforced concrete box, extension, base and cover. Furnish box with end and side knockouts and non-settling shoulders. Cover shall have hold-down bolts and two lifting eyes.

B. Size: As indicated on the Drawings.

C. Cover markings: Covers shall read "ELECTRICAL" or "SIGNAL" as appropriate or as noted on plans.

D. Rated covers: Use cast iron lid with H20 traffic rating when subject to vehicular traffic.

2.4 CONSTRUCTION MATERIALS

A. Mortar: Conform to ASTM C270, Type M, except for quantities less than 2.0 Cu. Ft., where packaged mix complying with ASTM C387, Type M may be used.

B. Concrete: Conform to Division 3: Cast-in-place concrete for concrete and reinforcing.

1. Strength: 3,000-PSI minimum 28-day compressive strength.

2. Aggregate for duct encasement: 3/8-inch maximum size.

PART 3 EXECUTION

3.1 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of duct and manhole installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 EARTHWORK

A. Excavation and backfill: Conform to Division 31, Earthwork.

B. Excavation for underground electrical structures: Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation or services, other construction and for inspection.

1. Excavate, by hand, areas within drip-line of large trees. Protect the root system for damage and dry-out. Maintain moist conditions for root system and over exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.

2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

C. Trenching: Excavate trenches for electrical installation as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearances on both sides of raceways and equipment.

2. Excavate trenches to depth indicated or required.

3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.

4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.

D. Trenching for concrete encased ducts:

1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 4-foot intervals to establish the grade and routing of the duct bank.

2. Pitch the trench uniformly towards manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward building wherever possible.

3. The walls of the trench may be used to form the sidewalls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.

4. After the concrete encased duct has sufficiently cured, the trench shall be backfilled to grade with earth.

E. Backfilling and filling: Place soil materials in layers to required sub-grade elevations for each area classification, using materials and methods specified in Division 31: Earthwork.

3.3 CONDUIT AND DUCT INSTALLATION

A. Install duct lines in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

B. Application:

1. Concrete encased ducts: Schedule 40, minimum 18 inches below finished grade.

2. Below roads and paved surfaces:

a. Schedule 80, minimum 36-inches below finished grade.

3. Penetrations of equipment slabs: PVC insulated rigid steel.

C. Slope duct to drain towards handholes and away from building and equipment entrances. Pitch not less than 4-inches per 100-feet. Curved sections in duct lines shall consist of long sweep bends with a minimum radius of 25-feet in the horizontal and vertical directions. The use of manufactured bends is limited to building entrances and equipment stub-ups.

D. Underground conduit stub-ups to inside of exterior equipment shall be PVC insulated rigid steel.

E. Make joints in ducts and fittings watertight according to Manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

F. Terminate duct lines at handholes with end bells spaced 10-inches on center for 5-inch ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10-feet from the end bell without reducing duct line slope and without forming trap in the line.

G. At manholes and pullboxes seal all empty conduits with expansion foam. Seal all conduits with cable using a cable seal system.

H. Separation between direct buried duct lines shall be 3-inches minimum for like systems and 12 inches minimum between power and signal ducts.

I. Concrete encased ducts:

1. Duct lines shall consist of single or multiple duct assemblies encased in concrete. Ducts material throughout the installation.

2. Rigid PVC spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 3-inches above bottom of trench during the concrete pour. Spacer spacing shall not exceed 5-feet.

3. Provide non-ferrous tie wires to prevent displacement of the ducts during pouring of concrete.

4. Separate ducts 3-inches for like systems and 6-inches between power and signal ducts.

J. For direct burial installations install continuous warning strip of heavy gage plastic imprinted "electrical ducts below", approximately 12-inch wide at 12-inches above ducts.

K. Mandrel and swab all ducts upon completion of installation and prior to pulling cables.

3.4 HANDHOLE AND PULL BOX INSTALLATION

A. Install handholes in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.

B. Handholes shall be installed flush with finished grade or surface. Install on a level 6-inch bed of well-tamped gravel or crushed stone.

C. Orientation of handholes shall be coordinated in advance with Landscape Architect and arranged to minimize connecting duct bends and deflections.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct and structures.

1. Duct integrity: Rod ducts with a mandrel 1/4-inch smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove the obstructions and retest.

3.6 CLEANING

A. Pull brush through full length of ducts. Use round bristle brush with a diameter 1/2-inch greater than internal diameter of duct.

B. Clean internal surfaces of handholes. Remove foreign material.

END OF SECTION 26 05 43 – Underground Ducts and Structures

SECTION 26 24 14

INTEGRATED DISTRIBUTION ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Integrated distribution assemblies consist of:

a. Overcurrent protection devices.

b. Panelboards.

c. Lighting Control Panel.

d. Equipment enclosure.

e. Weatherproof housing.

2. Completely pre-assembled switchgear includes:

a. Multiple section line-up incorporating above components.

b. Pre-wired from component to component as outlined on power single line diagram, where not split for shipping purposes.

c. Stacked panelboards.

B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1. Painting. Touch-up of painted surfaces.

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 (ANSI):

2. Federal Specifications (FS):

FS W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service.

FS W-P-115; Power Distribution Panel.

3. Underwriters Laboratories, Inc. (UL):

   UL 486E; Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.

   UL 489; Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

4. National Electrical Manufacturer Association (NEMA):

   NEMA AB1; Molded Case Circuit Breakers.

   NEMA PB 1; Panelboards.

   NEMA PB 1.1; Instructions for safety instruction, operation and maintenance of panelboard rated 600 volts or less.

1.3 SYSTEM DESCRIPTION

A. The integrated distribution assemblies shall be prefabricated unitized distribution panel containing overcurrent protection devices, panelboards, SPD, etc. for a complete distribution and branch circuiting package. Assemblies consist of multiple free-standing, deadfront type low-voltage distribution panel sections, aligned front and back and shipped as one assembly.

B. Distribution panels as indicated

C. Overcurrent protection devices shall be group mounted molded case circuit breakers within assembly.

D. 120/208 volt panelboards shall be for lighting and power branch circuiting.

1.4 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Shop Drawings to include:

   a. Front, plan and side view elevations with overall dimensions.

   b. Conduit entrance locations and requirements.

   c. Nameplate legends; size and number of bus bars per phase, neutral and ground.

d. Electrical characteristics including voltage, frame size and trip rating and withstand ratings.

e. Single line wiring diagram illustrating the components of assembly with interior wire connections and sizes.

3. Furnish structural calculations for equipment anchorage as described in Section 26 05 00 Basic Electrical Requirements.

4. Submit Manufacturer's installation instructions.

5. Complete Bill of Material listing all components.

6. Warranty.

B. Dimensions and configurations of integrated distribution assembly shall conform to the space allocated on the Drawings. The Contractor shall submit a revised layout if equipment furnished varies in size from that indicated on Drawings for the Engineer's approval.

1.5 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals in accordance with the requirements of Section 16010: Basic Electrical Requirements, to include the following:

1. A detailed explanation of the operation of the system.

2. Instructions for routine maintenance.

3. Pictorial parts list and part numbers.

4. Pictorial and schematic Electrical Drawings of wiring systems, including operating and safety devices.

5. Telephone numbers for the authorized parts and service distributors.

6. Include all service bulletins and torque Specifications for all terminations.

7. Final testing report.

1.6 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.

B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Integrated distribution assembly components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to the University. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with NEMA PB2.1 and Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.8 WARRANTY

A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the University.

1.9 SYSTEM START-UP

A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the integrated distribution assemblies. Sufficient time shall be allowed to properly checkout the system and perform required minor adjustments before the Engineer's witnessed test shall begin.

1.10 EXTRA MATERIAL

A. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

1. Pacific Utility Products

2. Tesco Controls

3. Or approved equal.

B. Substitutions: Under provisions of Section 26 05 00: Basic Electrical Requirements.

2.2 ASSEMBLIES - GENERAL

A. Enclosure:

1. Each assembly shall consist of a dead front, completely metal enclosed self-supporting structure. Construction shall consist of vertical sections of the universal frame type bolted together and braced with self-tapping bolts. Sides, top and rear shall be covered with captive-bolt fastened steel plates having formed edges all around. Front plates shall be sectionalized and removable. All plates shall be fabricated from 12 gage steel and shall have die-formed edges all around. The assembly frame shall be suitable for use as floor sills in indoor installations. Corners shall be reinforced with rigged gussets internal and external to the structural members. Provide ventilators located on the roof of the switchboard over the overcurrent protective device, transformer and bus compartments to ensure adequate ventilation within the enclosure. Provide additional ventilators in the transformer compartments in the front panels as required.

2. Assemblies shall have depth as required to house all equipment contained within it. Assemblies shall be constructed so that the back and front of all sections align. Construction of the gear shall allow maintenance of incoming line terminations, device connections and all bus bolted connections.

3. All devices shall be accessible and removable from the front.

4. Provide necessary hardware to permit locking overcurrent protective device handle in the "OFF" position when individually mounted in the distribution panel.

B. Bussing and terminations:

1. Assembly bus bars and connections shall consist of high conductivity silver-plated copper (1000 amps per square inch maximum) mounted on heavy duty glass polyester supports. Bolted connections using Belleville washers are required for all internal connections, including those between protective devices and bus.

2. Bus arrangement shall be Phase A-B-C-N left-to-right, top-to-bottom, front-to-rear as viewed from the front. Horizontal and vertical bus ampere rating shall be uniform from end-to-end.

3. All bussing to and from an overcurrent protective device shall be rated to the frame sizing, not the trip rating.

4. Each assembly shall contain bussing within the pull section for service and feed-through lugs as indicated on the Drawings. Ground bus shall be sized in accordance with UL 891, Table 25.1.

5. Termination lugs: High compression circumference crimped type rated for use with aluminum/copper conductors.

6. Assembly shall be rated for a minimum of 22,000 AIC.

7. Neutral bus shall be 100 percent rated unless otherwise indicated on the Drawings

C. Overcurrent protective devices:

1. Refer to Section 26 28 17: Overcurrent Protective Devices.

2. Individually mounted overcurrent protective device shall be fixed mounted type molded case circuit breaker with interrupting rating and frame and trip ratings as indicated on Drawings.

3. Devices interrupting rating shall match that of assembly for which the device is installed.

4. Devices shall be manually operated unless remote controlled circuit breaker devices are indicated on Drawings.

D. Integrated panelboards:

1. Refer to Section 26 24 16: Panelboards.

2. Panelboards shall be integral to the assembly 120/208 volt panels.

3. Refer to schedule on Drawings for panelboard ratings, circuit breaker capacity, quantity of sections, etc.

E. Miscellaneous requirements:

1. Nameplates: Engraved nameplates shall be provided for each device and all "SPACES" located in the distribution panel. An engraved nameplate shall also be provided indicating the distribution panel's designation. See Section 26 05 54: Electrical Identification for requirements.

2. All control wires shall be labeled with wire markers and referenced to the control wiring diagrams. Provide colored wires with colored stripes to facilitate trouble-shooting and locating both ends of wires. Do not use wires with all the same wire color. Use fork, crimp type terminations on all control wires.

3. Provide a test block and plugs for voltage and current monitoring at each main switch. Provide engraved legend plates to indicate function of each test point.

4. Vertically mounted mains shall have the operating handle in the up position when energized.

F. Finish:

1. Five step zinc phosphate pre-treatment, one coat of rust inhibiting dichromate primer and one coat of baked-on enamel finish, ANSI 61 (light gray).

2. A seven step spray wash, electroplate primer with final baked-on enamel finish, ANSI 61 (light gray) is an acceptable finish alternative.

2.3 WIRING AND TERMINATIONS

A. Small wiring and terminal blocks within the assembly shall be furnished as required. Control components mounted within the assembly shall be suitably marked for identification corresponding to appropriate designations on Manufacturer's wiring diagrams. All control components are wired to a terminal block.

B. Mechanical type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the Drawings.

C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the Drawings.

D. All control wire shall be bundled and secured. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All groups of control wires leaving the assembly shall be provided with terminals blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.4 SOURCE QUALITY CONTROL

A. Factory testing:

1. The integrated distribution assembly shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete distribution panel shall be tested for operation under simulated conditions to assure the accuracy of the wiring and the functioning of all equipment.

2. The main circuits shall be given a dielectric test of 2,200 volts for one minute between current carrying components and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1,500 volts for one minute between current carrying components and ground.

PART 3 EXECUTION

3.1 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of integrated distribution assembly installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 PREPARATION

A. Ensure all conduit stub-ups for bottom entry into integrated distribution assemblies are in place and located as required per Shop Drawings.

3.3 INSTALLATION

A. Install integrated distribution assembly in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

B. Handling, storage, installation and energize of integrated distribution assembly shall be carried out in accordance with latest edition of NEMA Publications PB 2.1.

C. Freestanding assembly shall be accurately aligned, leveled and bolted in place on full-length channels securely fastened to concrete floor.

D. Assembly shall be anchored and braced to withstand seismic forces as calculated per Section 26 05 00: Basic Electrical Requirements.

E. "Train" interior wiring; bundle and clamp, using specified plastic wire wraps specified under Section 26 05 19: Building Wire and Cable.

F. Replace any distribution panel pieces, doors or trims having dents, bends, warps or poor fit that may impede ready access, security or integrity.

G. Conduits terminating in concentric, eccentric or oversized knockouts at assembly shall have ground bushings and bonding jumpers installed interconnecting all such conduits and the enclosure.

H. Check and tighten all bolts and connections with a torque wrench using Manufacturer's recommended values.

I. Visually inspect assembly for rust and corrosion. If signs of rust and corrosion are present, assembly shall be restored to new condition or replaced.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's field service: Contractor shall arrange for the services of a factory-authorized service representative to supervise the initial start-up, pretesting and adjustment of the integrated distribution assembly.

B. Independent testing: Contractor shall arrange and pay for the services of an independent Testing Agency to perform all quality control electrical testing, calibration and inspection required herein. Testing Agencies objectives shall be to:

1. Assure integrated distribution assembly installation conforms with specified requirements and operates within specified tolerances.

2. Field test and inspect to ensure operation in accordance with Manufacturer's recommendations and Specifications.

3. Prepare final test report including results, observations, failures, adjustments and remedies.

4. Apply label on assembly upon satisfactory completion of tests and results.

5. Verify ratings and settings and make final adjustments.

C. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily and a written report provided for review prior to the Engineer's witnessed test.

D. The Contractor shall supply a suitable and stable source of electrical power to each test site. The Testing Agency shall specify the specific power requirements.

E. Testing of overcurrent protective devices shall be done only after all devices are installed and system is energized.

F. Pretesting:

1. Insulation resistance tests of buses, components, feeders and branch circuit conductors and control circuits.

2. Continuity tests of circuits.

3. Provide Testing Agency with Contract Documents and Manufacturer instructions for installation and testing.

G. Visual and mechanical inspection:

1. Inspect for physical damage, defects alignment and fit.

2. Perform mechanical operational tests in accordance with Manufacturer's instructions.

3. Compare nameplate information and connections to Contract Documents.

4. Check tightness of all control and power connections.

5. Check that all covers, barriers and doors are secure.

6. Verify that relays and overcurrent protective devices meet specified requirements.

H. Electrical tests:

1. Insulation resistance: 1,000 volt DC tests for one minute on all 600 volt and lower rated equipment, components, buses, feeder and branch circuits and control circuits. Test phase-to-phase and phase-to-ground circuits showing less than 10 megohms resistance to ground shall be repaired or replaced.

2. Circuit continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.

3. Test overcurrent protection devices per Section 26 28 17: Overcurrent Protective Devices.

I. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation, the Manufacturer shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Engineer's hourly rate and mileage cost.

J. Manufacturer shall replace at no costs to the University all devices which are found defective or do not operate within factory specified tolerances.

K. Contractor shall submit the Testing Agency's final report to the Engineer for review prior to Project closeout and final acceptance by the University. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.5 CLEANING

A. Prior to energizing of integrated distribution assembly the Contractor shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using Manufacturer's approved methods and materials.

B. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean both the interior and exterior of switchboard per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt and debris.

C. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

3.6 TRAINING

A. Factory authorized service representative shall conduct a 4 hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both classroom training and hands-on instruction.

B. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION 26 24 14 – Integrated Distribution Assemblies

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Branch circuit panelboards.

B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified.

1. National Electrical Manufacturers Association (NEMA):

NEMA AB 1; Molded Case Circuit Breakers.

NEMA PB 1; Panelboards.

NEMA PB 1.1; Instructions for safety instruction, operation and maintenance of panelboard rated 600 volts or less.

1.3 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards

2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Shop drawings: Include elevations, cabinet dimensions, gutter sizes, layout of contactors, relays, time clocks, lug sizes, bussing diagrams; make, location and capacity of installed equipment; mounting style; finish and panelboard nameplate inscription.

4. Submit structural calculations for equipment anchorage as described in Section 26 05 00: Basic Electrical Requirements.

5. Submit manufacturer's installation instructions.

6. Complete bill of material listing all components.

7. Warranty.

B. Dimensions and configurations of panelboards shall conform to the spaces allocated on the Drawings for their installation. The contractor shall include with the submittal a layout of the electrical room if it differs from construction documents for review and approval by the University's Representative prior to release of order.

1.4 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, to include the following:

1. A detailed explanation of the operation of the system.

2. Instructions for routine maintenance.

3. Pictorial parts list and parts number.

4. Telephone numbers for authorized parts and service distributors.

5. Final testing reports.

1.5 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Only products and applications listed in this Section may be used on the project unless otherwise submitted.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Panelboard components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no additional cost to University.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with NEMA PB1.1 and manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

1.7 WARRANTY

A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the University.

1.8 EXTRA MATERIAL

A. Turn over two (2) sets of panelboard keys to the University at completion of project. All panelboards shall be keyed alike.

B. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

1. Cutler-Hammer.

2. General Electric.

3. Siemens/I-T-E.

B. Substitutions: Under provisions of Section 26 05 00: Basic Electrical Requirements.

2.2 PANELBOARDS - GENERAL

A. Enclosure:

1. Cabinets shall be NEMA Type 1 enclosure, door and trim of code gauge galvanized steel or open chasse when installed in a panel or indicated on the drawings.

2. Panelboard covers shall be door-in-door construction such that inner door exposes the overcurrent protective devices and the outer door exposes the complete panelboard interior (i.e. branch circuit conductors, lugs, neutral and ground bus, overcurrent protective devices, etc.). Outer door shall have full-length piano hinge and inner door shall have two-point hinges.

3. Provide combination spring catch and lock on inside edge of the inner door trims with flush fitting joint between door and trim. Locks on all panelboards shall be keyed alike. Doors 36 inches and over in height shall be provided with three-point catch and lock. Provide quarter-turn captive bolts on the outer door.

4. There shall be no Contractor advertisements displayed within the panelboards indicated who to contact for maintenance or anything else.

B. Bus assembly and terminations:

1. Bus shall be bolted copper with taps arranged for distributed phase connections to branch circuit devices

2. Cross connectors shall be copper, drilled and tapped for bolt-on device connections, arranged for double row placement of device and designed to permit removal or addition of overcurrent protection devices without disturbing adjacent devices or removing main bus connections.

3. Neutral bus shall be 100 percent rated of phase bus bars and shall have lugs for each outgoing branch circuit or feeder requiring a neutral connection unless otherwise noted.

4. Ground bus shall be full size with lugs for each outgoing branch circuit and feeder

5. Refer to panelboard schedules on drawings for bus rating. Bus rating shall match or be greater than main device or main lug rating.

6. As a minimum, bus bars shall be rated 22,000 AIC for 120/208 volt panelboards and 25,000 AIC for 277/480 volt panelboards. Unless otherwise noted.

7. Provide full sized bussing in all sections of multi-section panelboards.

8. No panelboard section shall have greater than 42 poles.

9. Termination Lugs: Rated for use with aluminum/copper conductors.

10. All "SPACES" shall be ready for installation of future overcurrent protective device.

C. Miscellaneous requirements:

1. Circuit numbering: Starting at the top, indicate odd numbered circuits in sequence down the left hand side and even numbered circuits down the right hand side. Multi-section panelboards shall have continuous consecutive circuit numbers, i.e. Section 1 (circuit numbers 1-42), Section 2 (circuit numbers 43-84), Section 3 (circuit numbers 85-126). Provide metal embossed circuit identification of panelboards.

2. Directories: A 6" x 8" minimum size circuit directory frame and card with clear plastic covering shall be provided inside the inner panelboard door to reflect conditions at completion of work. Directory shall be typewritten denoting loads served by room number or area for each circuit.

3. Nameplates: Provide engraved nameplate for each panelboard. See Section 26 05 54: Electrical Identification for requirements.

D. Refer to Panelboard Schedules for the following:

1. Mounting style; service voltage; location; bus ampacity; interrupting capacity of bus and breakers; quantity, poles and rating of overcurrent protective devices.

E. Overcurrent protective devices:

1. Refer to Section 26 28 17: Overcurrent Protection Devices.

2. Overcurrent protective devices shall be molded case circuit breakers as indicated on panelboard schedules or electrical drawings.

3. Main devices shall be hard bus connected to the panelboard bus bars.

4. In all cases, panelboards fed directly from a transformer shall have a main overcurrent protective device. If not shown on the Drawings or Panelboard Schedules, provide this device sized to provide the full capacity of the transformer rating.

5. Main devices shall be vertically mounted and shall have their operating handle in the up position when energized. Main devices that are mounted in the same manner as the branch devices are NOT acceptable; i.e. main devices shall be individually mounted at the top or bottom of the phase bus bars.

6. Panelboards overcurrent protective devices layout shall conform to the layout shown on the panelboard schedules.

F. Finish: Five step zinc phosphate pre-treatment, one coat of rust inhibiting dichromate primer and one coat of baked-on enamel finish, ANSI 61 (light gray).

PART 3 EXECUTION

3.1 EXAMINATION

A. Thoroughly examine site conditions for acceptance of panelboard installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 INSTALLATION

A. Install panelboards in accordance with manufacturer's written instructions, as shown on the drawings and as specified herein.

B. Set panels plumb and symmetrical with building lines in conformance with PB1.1. Furnish and install all construction channel bolts, angles, etc., required to mount the equipment furnished under this Section.

C. Mounting height shall be 6 feet to top of panelboard or as indicated on drawings.

D. Panelboards shall be anchored and braced to withstand seismic forces as calculated per Section 26 05 00: Basic Electrical Requirements.

E. Provide mounting hardware brackets, busbar drillings and filler pieces for all unused spaces.

F. "Train" interior wiring; bundle and clamp, using specified plastic wire wraps specified under Section 26 05 19: Building Wire and Cable.

G. Replace panel pieces, doors, or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.

H. Conduits terminating in concentric, eccentric or oversized knockouts at panelboards shall have ground bushings and bonding jumpers installed interconnecting all such conduits and the panelboard.

I. Check and tighten all bolts and connections with a torque wrench using manufacturer's recommended values.

J. Visually inspect panelboard for rust and corrosion. If signs of rust and corrosion are present, restore or replace panelboard to new condition.

K. In damp and wet locations mount panelboards with a minimum one inch of air space between cabinet and the wall or other supporting material.

L. Provide close up plugs in all unused openings in the cabinet.

3.3 FIELD QUALITY CONTROLS

A. Independent testing: Arrange and pay for the services of an independent testing agency to perform all quality control electrical testing, calibration and inspection required herein. Testing agencies objectives shall be to:

1. Assure panelboard installation conforms to specified requirements and operates within specified tolerances.

2. Field test and inspect to insure operation in accordance with manufacturer's recommendations and specifications.

3. Prepare final test report including results, observations, failures, adjustments and remedies.

4. Apply label on panelboards upon satisfactory completion of tests and results.

5. Verify ratings and settings and make final adjustments.

B. At least three weeks prior to any testing, notify the University’s Representative so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the University’s Representative witnessed test.

C. Supply a suitable and stable source of electrical power to each test site. The testing agency shall specify the specific power requirements.

D. Testing of overcurrent protective devices shall be done only after all devices are installed and system is energized.

E. Prefunctional testing:

1. Provide testing agency with contract documents and manufacturer instructions for installation and testing.

2. Visual and mechanical inspection:

a. Inspect for physical damage, defects alignment and fit.

b. Perform mechanical operational tests in accordance with manufacturer's instructions.

c. Compare nameplate information and connections to contract documents.

d. Check tightness of all power connections.

e. Check that all covers, barriers, and doors are secure.

3. Electrical tests:

a. Insulation resistance: 1,000 volt DC tests for one minute on all 600 volt and lower rated equipment, components, buses, feeder and branch circuits, and control circuits. Test phase-to-phase and phase-to-ground circuits showing less than 10 megohms resistance to ground shall be repaired or replaced.

b. Circuit continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.

c. Ground resistance: Test resistance to ground of system and equipment ground connection.

d. Test overcurrent protection devices per Section 26 28 17: Overcurrent Protective Devices.

F. In the event that the system fails to function properly during the testing, as a result of inadequate pretesting or preparation, the contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the University Representative’s hourly rate.

G. Replace at no additional costs to the University all devices that are found defective or do not operate within factory specified tolerances.

H. Submit the testing agency's final report for review prior to project closeout and final acceptance by the University. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.4 CLEANING

A. Prior to energizing of panelboards the contractor shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using manufacturer's methods and materials.

B. Upon completion of project prior to final acceptance the contractor shall thoroughly clean both the interior and exterior of panelboards per manufacturers recommended materials and methods. Remove paint splatters and other spots, dirt, and debris.

C. Touch-up paint any marks, blemishes, or other finish damage suffered during installation.

END OF SECTION 26 24 16 - Panelboards

SECTION 26 28 17

OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Molded case circuit breakers.

B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. Underwriters Laboratories, Inc. (UL):

UL 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures.

2. National Electrical Manufacturer Association (NEMA):

NEMA AB 1; Molded Case Circuit Breakers.

1.3 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Describe product operation, equipment, and dimensions and indicate features of each component.

3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

4. Provide factory certification of trip characteristics for each type and rating of circuit breaker.

5. Provide current let-through and melting time information for each type and rating of fuses.

6. Submit manufacturer's installation instructions.

7. Complete bill of material listing all components.

8. Warranty.

1.4 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, to include the following:

1. A detailed explanation of the operation of the system.

2. Instructions for routine maintenance.

3. Parts list and part numbers.

4. Telephone numbers for authorized parts and service distributors.

5. Final testing reports.

1.5 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.

B. Only products and applications listed in this Section may be used on the project unless otherwise submitted.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Overcurrent Protective Device components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no additional cost to University.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

1.7 WARRANTY

A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the University.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

1. Circuit breakers:

a. Cutler-Hammer.

b. General Electric.

c. Siemens/I-T-E.

B. Substitutions: Under provisions of Section 26 05 00: Basic Electrical Requirements.

2.2 MOLDED CASE CIRCUIT BREAKERS

A. Individually mounted and panelboard mounted, branch and feeder circuit breakers shall be molded case, bolt on and trip indicating.

B. Where stationary molded case circuit breakers are shown on the drawings to be current limiting type, they shall be current limiting as defined by UL 489 and shall not employ any fusible elements.

C. Circuit breakers shall have interrupting capacity not less than that shown on the drawings, or if not shown, not less than 25,000 RMS symmetrical amps for 480 volt systems and 22,000 RMS symmetrical amps for 208 volt systems.

D. Covers shall be sealed on non-interchangeable breakers, and trip unit covers shall be sealed on interchangeable trip breakers to prevent tampering. Circuit breaker ratings shall be clearly visible after installation, or engraved nameplates shall be provided stating the rating. All ferrous parts shall be plated to minimize corrosion.

E. Circuit breakers shall be toggle, quick-make and quick-break operating mechanisms with trip-free feature to prevent contacts being held closed against overcurrent conditions in the circuit. Trip position of the breakers shall be clearly indicated by operating handles moving to a center position.

F. Multipole breakers shall have a single handle to open and close all contacts simultaneously in both manual operation and under automatic tripping. Interpole barriers shall be provided inside the breaker to prevent any phase-to-phase flashover. Each pole of the breaker shall have means for Arc extinguishing.

G. All terminals shall be rated at 75 degrees C for aluminum or copper wire.

H. Circuit breakers with trip ratings 100 amp and smaller shall be ambient temperature compensated, thermal magnetic type unless otherwise noted. Breakers shall be of full size, 1 inch per pole type. Panels with more than one branch breaker larger than 100 amps shall be installed in distribution type panels.

I. Circuit breakers with trip ratings 101 amps through 400 amps shall have solid state electronic trips with true RMS reading through the 13th harmonic with 1% accuracy, interchangeable trip via front accessible current plug, adjustable instantaneous and short time be rated as shown on drawings at the voltage indicated.

J. Accessories: Provide accessories as noted on the drawings, i.e. shunt-trip, auxiliary contacts, undervoltage trip, alarm switch, etc.

K. Spaces in the panelboards shall be able to accept any combination of 1, 2 or 3 pole circuit breakers as indicated. Provide all necessary bus, device supports and mounting hardware sized for frame, not trip rating.

L. Series rated breakers are not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Thoroughly examine site conditions for acceptance of overcurrent protective device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 INSTALLATION

A. Install overcurrent protective devices in accordance with manufacturer's written instructions, as shown on the drawings and as specified herein.

B. Tighten electrical connectors and terminals; including screws and bolts, in accordance with equipment manufacturers published torque-tightening values for equipment connectors. Where manufacturers torque requirements are not indicated tighten connectors and terminals to comply with tightening torque specified in UL Standard 486A.

C. Install overcurrent protective devices and accessories in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. All devices shall be installed in accordance with applicable NEC and NEMA standards for installation.

3.3 FIELD QUALITY CONTROL

A. Independent testing: Arrange and pay for the services of an independent testing agency to perform all quality control electrical testing, calibration and inspection required herein. Testing agencies objectives shall be to:

1. Assure overcurrent protective device installation conforms to specified requirements and operates within specified tolerances.

2. Field test and inspect to insure operation in accordance with manufacturer's recommendations and specifications.

3. Prepare final test report including results, observations, failures, adjustments and remedies.

4. Verify ratings and settings and make final adjustments.

B. At least three weeks prior to any testing, notify the University's Representative so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the University's Representative witnessed test.

C. Supply a suitable and stable source of electrical power to each test site. The testing agency shall specify the specific power requirements.

D. Testing of overcurrent protective devices shall be done only after all devices are installed and system is energized.

E. Prefunctional testing:

1. Provide testing agency with contract documents and manufacturer instructions for installation and testing.

2. Visual and mechanical inspection:

a. Inspect for physical damage, defects alignment and fit.

b. Perform mechanical operational tests in accordance with manufacturer's instructions.

c. Compare nameplate information and connections to contract documents.

d. Check tightness of all control and power connections.

e. Check that all covers, barriers, and doors are secure.

3. Electrical tests:

a. Circuit continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.

b. Determine that circuit breaker will trip under overcurrent condition, with tripping time in conformance with NEMA AB 1 requirements.

c. Test all circuit breakers with frame size 225 amps and larger and 10 percent of all circuit breakers with frame sizes less than 225 amps in each panelboard, distribution board, switchboard, etc. unless otherwise noted.

F. Replace at no additional costs to the University all devices that are found defective or do not operate within factory specified tolerances.

G. Submit the testing agency's final report for review prior to project closeout and final acceptance by the University. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.4 ADJUSTING

A. Adjust circuit breaker trip settings for coordination with other overcurrent protective devices in system.

B. Adjust circuit breaker trip settings for adequate protection from overcurrent and fault currents.

3.5 CLEANING

A. Upon completion of project prior to final acceptance the contractor shall thoroughly clean overcurrent protective devices per manufacturer's recommended materials and methods. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 26 28 17 – Overcurrent Protective Devices

SECTION 26 50 02

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Site lighting fixtures.

2. Diodes.

3. LED drivers.

4. Pole standards.

B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

1. Division 3: Cast-in-place concrete. Light pole foundations and backboxes.

2. Division 5: Miscellaneous. Fittings, brackets, backing supports, rods, etc. as required for support and bracing of lighting fixtures.

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 (ANSI):

ANSI C78.377; Specifications for Chromaticity of Solid State Lighting Products.

ANSI C136.37; LED Luminaires.

ANSI 8750; Standards for Light Emitting Diode (LED) Equipment for Use in Lighting Products.

2. Underwriters Laboratories, Inc. (UL):

UL 66; Fixture Wire.

UL 8750; Light Emitting Diode (LED) Equipment for Use in Lighting Products.

UL 1598; Luminaires.

3. National Electrical Manufacturer Association (NEMA):

   NEMA SSL 1; Electronic Driver for LED Devices, Arrays or Systems.

   NEMA SSL 3; High Power White LED Binning for General Illumination.

4. Restriction of Hazardous Substances in LED (RoHS):

   EU RoHS; Directive 2002/95/EC Restriction of Hazardous Materials.

1.3 SUBMITTALS

A. Submit in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

3. Independent Testing Laboratories, Inc. or equal, photometric test report for each luminaire type and lamp combination listed on the fixture schedule. Test reports shall be based on Illuminating Engineering Society published test procedures and shall contain candlepower distribution curves in five lateral planes for fixtures with asymmetric distributions and fixture luminance data for vertical angles above 45 degrees from nadir.

4. Submit Manufacturer's installation instructions.

5. Complete bill of material listing all lighting fixtures and components.

6. Warranty.

1.4 OPERATION AND MAINTENANCE MANUAL

A. Supply operation and maintenance manuals in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, to include the following:

1. A detailed explanation of the operation of the system.

2. Instructions for routine maintenance.

3. Pictorial parts list and part numbers.

4. Telephone numbers for the authorized parts and service distributors.

1.5 QUALITY ASSURANCE

A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.

B. Only products and applications listed in this Section may be used on the Project unless otherwise submitted.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Lighting fixtures shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to Manufacturer at no cost to Owner.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with Manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.

1.7 WARRANTY

A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

1. Lamps:

a. Cree (LED)

2. LED drivers:

a. Osram Sylvania

b. North American Philips Lighting Co. (NAPLC)

B. Substitutions: Under provisions of Section 26 05 00: Basic Electrical Requirements.

2.2 LAMPS

A. Light emitting diodes (LED):

1. Refer to the Fixture Schedule for type of LED lamps required.

2. All diodes shall come from the same manufacturer and carry the same bin number.

3. All diodes shall be tested and tuned for the optimal Kelvin color point.

4. Color correlated temperature: 4000K or as specified in the fixture schedule.

5. Minimum CRI (Color Rendering Index): 80

6. LED fixture components shall be free of all toxic materials to include lead, cadmium and mercury, and shall be RoHS compliant.

7. Groups of three or more diodes in a single housing shall be tested for even distribution.

8. Standard lumen output shall meet or exceed the State of California Title 24 Energy Code for high efficiency luminaries.

9. All LED fixtures shall have an IES formatted electronic photometric report.

10. Diodes shall have a minimum life of 50,000 hours and maintain at least 70% of initial lamp lumens throughout this period.

2.3 DRIVERS

A. LED Drivers:

1. LED drivers shall be integral to fixture housing.

2. Drivers shall have a minimum life of 50,000 hours and maintain at least 70% of initial lamp lumens for that period.

2.4 FIXTURES

A. Refer to the Fixture Schedule.

B. The finish of all fixtures and trim shall be submitted to and approved by the Architect prior to ordering.

C. All standard fixtures must bear UL label. Attaching of labels after delivery of fixtures is not acceptable.

2.5 POLES

A. Wind-load strength: 80 mph and 1.3 gust factor for total support assembly, including pole, base and anchorage, where used, to carry the fixtures, supports and appurtenances at the indicated heights above grade without deflection or whipping.

B. Arm, bracket and tenon mount materials: Match the poles.

C. Mountings, fastenings and appurtenances: Corrosion-resistant components compatible with the poles and fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position the luminaire to provide the indicated light distribution.

D. Pole shafts: Round straight.

E. Handhole: Provide handhole and cover near base of pole shaft for access to wiring compartment.

F. Grounding lug: Provide grounding lug for grounding conductor with access through handhole.

G. Pole bases: Anchor type with galvanized steel hold-down or anchor bolts, leveling nuts and bolt covers.

H. Steel poles: Steel tubing conforming to ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psi. Poles are 1-piece construction up to 40 feet in length and have access handhole in wall.

I. Pole-top tenons: Fabricated to support the fixture indicated and securely fastened to the pole top.

PART 3 EXECUTION

3.1 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of site lighting fixture installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 PREPARATION

A. Consult Civil Drawings for details of construction area, finish, landscape features and other applicable details and provide suitable installation for each location.

3.3 INSTALLATION

A. Install lighting fixtures in accordance with Manufacturer's written instructions, as indicated on the Drawings and as specified herein.

B. Contractor shall be responsible for all supports, hangers and hardware necessary for a complete installation.

C. Fixtures shall be plumb, level, square, in straight lines and without distortion. Remedy light leaks that may develop after installation of recessed or enclosed fixtures.

D. Turn over Project with all lamps in new and operating condition. Lamps that are burned less than 100 hours at Project closeout are considered new.

3.4 IDENTIFICATION SYSTEM

A. All pole mounted fixtures handhole cover plate (interior) shall be clearly marked with permanent black ink felt pen identifying the branch circuit (both panel designation and circuit number).

3.5 INSTALLATION OF POLES

A. General: Store poles on decay-resistant treated skids at least 1 ft. above grade and vegetation. Support pole to prevent distortion and arrange to provide free air circulation.

B. Metal poles: Retain factory-applied pole wrappings until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

C. Pole installation: Use fabric web slings (not chain or cable) to raise and set poles.

3.6 CONCRETE FOUNDATIONS

A. Construct concrete foundations with 3000 pound, 28 day concrete conforming to Division 3, Section "Cast-In-Place Concrete." Comply with details and Manufacturer's recommendations for reinforcing, anchor bolts, nuts and washers.

3.7 FIELD QUALITY CONTROL

A. Visual and mechanical inspection:

1. Inspect for physical damage, defects, alignment and fit.

2. Perform operational test of each lighting fixture after installed, circuited and energized.

3. Perform emergency operational test of all lighting fixtures connected to emergency circuiting by interrupting normal power source.

B. Contractor shall replace at no cost to the Owner all equipment which is found defective or do not operate within factory specified tolerances.

3.8 CLEANING

A. Clean lighting fixtures prior to Project closeout in accordance with Manufacturer's recommended materials and methods.

END OF SECTION 26 50 02 – Exterior Lighting

SECTION 27 00 00

COMMUNICATIONS BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes, but is not necessarily limited to:

1. Common standards and procedures for the Communications Work.

2. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Communications Systems. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

B. Provisions of this Section apply to Communications Work, including the following Sections:

1. Section 27 05 26 – Communications Grounding and Bonding

2. Section 27 05 28 – Communications Pathways

3. Section 27 05 30 – Communications Identification

4. Section 27 15 13 – Communications Structured Cabling, Basic Materials and Methods

5. Section 27 20 00 – Communications Termination Blocks and Patch Panels

6. Section 27 13 14 – Communications Backbone OSP Twisted Pair Cabling

7. Section 27 50 00 – Ring-Down Emergency Telephones

1.2 REFERENCES

A. Usage: In accordance with Regulatory Requirements.

B. American National Standards Institute (ANSI)

1. ANSI/TIA/EIA-568-B.1-2001, Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements

2. ANSI/TIA/EIA-568-B.2-2001, Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components

3. ANSI/TIA/EIA-606-A-2002, Administration Standard for Commercial Telecommunications Infrastructure

1.3 DEFINITIONS

A. See Abbreviation, Symbol & Definitions.

B. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.

1.	ADA	Americans With Disabilities Act.
2.	AFC	Above Finished Ceiling.
3.	AFF	Above the Finished Floor.
4.	BLDG	Building
5.	CAT	Category
6.	CL	Centerline
7.	DIV	Division
8.	(E)	Existing
9.	FBU	Furnished By University
10.	HR	Home Run
11.	ID	Inside Diameter
12.	LAN	Local Area Network
13.	MAX	Maximum
14.	NIC	Not In Contract.
15.	OD	Outside Diameter
16.	PSRH	Project Standard Receptacle Height.
17.	PSSH	Project Standard Switch Height.
18.	TYP	Typical
19.	UFE	University Furnished Equipment.
20.	UON	Unless Otherwise Noted.

C. Electrical and electronics terms used in the Communications Sections shall be as defined in:

1. ANSI/TIA/EIA-568-B.1

2. ANSI/TIA/EIA-568-B.2

3. ANSI/TIA/EIA-568-B.3

4. ANSI/TIA/EIA-569-B

5. ANSI/TIA/EIA-606-A

6. IEEE - Std 100

7. This Section.

D. Campus Distributor (CD) - A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

E. Building Distributor (BDF) - A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

F. Floor Distributor (FD) - A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

G. Telecommunications Room (TR) - An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

H. Entrance Facility (EF) (Telecommunications) - An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

I. Entrance Room (ER) (Telecommunications) - A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

J. Open Cable - Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is open to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

K. Open Office - A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

L. Pathway - A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SUBMITTALS

A. Comply with Division 1 – Shop Drawings, Product Data and Samples and the following.

1. Submit all materials for review arranged in same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.

2. Submit 8 ½"x 11" items bound in volumes and drawings in edge bound sets. Submit all drawings on sheets of the same size.

3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.

4. Progress Schedule: Comply with Division 1 - Contract Schedules.

B. Contractor and Key Personnel Experience.

1. A minimum of 30 days prior to installation, submit documentation of the experience of the low voltage systems, equipment and infrastructure contractor(s) and of their key personnel.

2. Qualifications shall be provided for:

a. The low voltage systems, equipment and infrastructure contractor(s),

b. The low voltage systems, equipment and infrastructure installers,

c. The supervisor(s) (if different from the installers).

3. Refer to Quality Assurance paragraph in this section for complete requirements.

C. Manufacturer's Product Data:

1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials:

2. Data sheet for each item in each Communications Section, including all accessories, clearly marked for proposed product.

3. Material Safety Data Sheet, where applies.

4. List of Materials Schedule. For each item, include:

a. Referencing Specification Section

b. Referencing Paragraph

c. Referencing Drawing, if specified only on plans

d. Manufacturer.

e. Model number.

f. Listing, including name of Nationally Recognized Testing Laboratory.

g. Precede each submittal book with a summary schedule, with columns for each item above and rows for each item submitted.

i. Example:

Specification Section	Paragraph	Contract Drawing Reference	Manufacturer	Model No.	UL/ CLA Listed
27 00 00	2.03 C.		XYZ	123	Y
27 13 14	2.07 A. 1.		AAA	34-56	Y
		L-T7.2	ZZY	456	Y

D. Field (Installation) Drawings:

1. General

a. Drawings shall use the present and the proposed installation using the makes and models of devices proposed for use this project; replace vendor neutral nomenclature used in bid set with.

b. Where the existing systems and/or infrastructure are used and integrated into the work of the project, indicate them on drawings, including points of interface and demarcation of existing and new work.

c. Collate, in sequence, at least the following minimum drawings, for each infrastructure and system to be installed under the work of this contract:

2. Drawing index/symbol sheet.

3. Site plans, floor plans and reflected ceiling plans.

a. General

i. The identifier for each termination and cable shall appear on the drawings, either directly on the floor plans, through an associated schedule or a unique identifier associated with a fully annotated single line diagram.

ii. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

iii. At scale of Contract Documents, show:

(1) Device locations and type

(2) Rough-in.

(3) Mounting height.

(4) Conduit size.

(5) J-hook routes

(6) Wire type.

(7) Wire fill.

iv. On the floor plans, indicate floor and wall mounted devices and pathway below a height of 7 feet above finish floor. Indicate the locations of the communications rooms and provide reference to the enlarged communications rooms plans.

v. On the reflected ceiling plan, indicate ceiling and wall mounted devices and pathway above a height of 7 feet above finish floor. Indicate the locations of the communications rooms and provide reference to the enlarged communications rooms plans.

b. Communications Infrastructure

i. Provide registered communications distribution designer (RCDD) approved, drawings depicting a complete communication infrastructure in accordance with ANSI/TIA/EIA-606-A. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the communications rooms including EF, ER, CD's, BD's, and FD's to the telecommunications work area outlets.

ii. The following drawings shall be provided as a minimum:

(1) T1- Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

(2) T-2 Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

c. Audiovisual Systems, including MATV Systems, Audiovisual Systems and Public and Mass Notification Systems

i. Indicate:

(1) Device locations, orientation and depict integration of systems that need to be viewed from the complete building perspective.

(2) For distributed speaker systems, indicate limits of zones of coverage.

(3) Vertical and horizontal pathways

(4) Equipment rooms and racks

(5) Reference to enlarged plans and related details.

4. Enlarged Plans

a. General

i. Indicate at least as much information as is provided in the Contract Documents, supplemented by the dimensions and arrangement of the proposed equipment, trade coordination and field conditions.

b. Communications Infrastructure.

i. Communications Rooms Drawings

(1) Provide T3 drawings in accordance with EIA TIA/EIA-606-A that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Include rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

(2) At scale of Contract Documents, the Contractor shall submit scaled drawing elevations (showing dimensions, mounting locations and associated frames & equipment) for all required assemblies, including but not limited to:

(a) Rack locations

(b) Wall mounted plywood backboards

(c) Wall mounted backbone cabling and major station cable bundles.

(d) Wall mounted and tray mounted splice cases

(e) Wall mounted copper cable protectors and terminal blocks.

(f) Wall mounted fiber optic cable terminations.

(g) Clearances

(h) Backboard Wire and Cable Management

(i) Rack elevations, including

(j) Copper cable patch panels.

(k) Fiber optic cable patch panels.

(l) Rack mounted wire managers

(m) Hold clears for equipment provided by Others.

(n) Reference to mounting details.

(o) Power strips

(p) UPS

ii. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

c. Audiovisual Systems, including MATV Systems, Audiovisual Systems and Public and Mass Notification Systems

i. At equipment rooms

(1) Rack elevations, showing

(a) all equipment occupying the actual number of rack units required

(b) blank panels

(c) vent panels

(d) aux panels

(e) power strips

(f) UPS

(g) Reference mounting details.

5. System Conduit and Riser Diagrams,

a. General:

i. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.

ii. Single line diagram of structured wiring

iii. Grounding and bonding scheme

iv. Terminal cabinets.

v. Coordination with floor plans.

vi. Wire runs not shown on floor plans.

vii. Wire type.

viii. Wire fill.

ix. Interface to work provided by work of other Sections, University Furnished Equipment, existing equipment and/or future equipment.

x. For Audiovisual Systems, including MATV Systems, Audiovisual Systems and Public and Mass Notification Systems, indicate digital or analog signal type and voltage levels (dBmV, microphone, line level, speaker level) or optical signal levels.

6. Detail Drawings

a. Mounting details:

i. Specific details of restraints including anchor bolts submitted under the Section 16710 – Hangers and Supports for Communications Systems for mounting and maximum loading at each location, showing compliance and coordination with Code and the project Architectural, Structural and Mechanical Documents.

ii. Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type.

(1) Submit an accompanying Engineering analysis stamped and signed by an Engineer licensed in California for work of this type, indicating that the Equipment Enclosure System will comply with California Building Code for the Project Seismic Zone when loaded with the weight of the equipment submitted.

(2) Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.

iii. Show loads, type and strength of connections, sizes, dimensions, materials, etc.

iv. Provide details for:

(1) Equipment Rack anchorage.

(2) Wall Mounted Racks and Enclosures.

(3) Cable Runway and Cable Tray

(4) Blue Light Telephone Tower

b. Faceplate and Receptacles

i. Receptacle and jack arrangement for each condition.

ii. Labeling of receptacle/jacks and plate

iii. Plate material.

iv. Plate finish.

v. Connector types.

vi. Connector dimensioned layout.

c. Pathway

i. Cable tray installation details, indicating complete system of fittings and radiussed pathways provided.

ii. Firestopping

iii. Details of flexible raceway connections to be made to vibrating equipment

iv. Details of J-Box and sealant application for the typical conditions listed in Section 16735 – Noise and Vibration Controls for Communications System, and a schedule of rooms to receive application of mastic and sealant at J-Boxes

v. An itemized list of all items of equipment to be fitted with flexible electrical connections.

vi. Conduit racking details.

d. California Access Compliance Manual and Americans with Disabilities Act (ADA) compliance.

e. For systems with contractor or manufacturer programmed control and human interfaces submit at least:

i. Narrative of the sequence of operation.

ii. Color, full-size layouts of each touchpanel and/or computer screen (menu) image, cross-referenced to the sequence of operations.

iii. Show chaining of sub-menus.

f. Terminal cabinets: Terminations.

g. Voice cable plant: Cut sheets for use by University's Telephone Systems Contractor

E. Samples: Samples for review by the University's Representative of all finishes/materials which will be visible to the public, including but not limited to:

1. Receptacles. The Contractor shall submit a mock up sample of each type of communication outlet including conduit, wall box, faceplate, communication cables, jacks and jack identifying labels.

2. The Contractor shall submit a sample of each type of label to be used for labeling cables, patch panels, termination frames, and faceplates for the telephone and data systems.

3. Surface Raceway, for each type:

a. Raceway base and cover, at least 5 foot section.

b. Boxes, at least two of each type to be used.

c. For other items, provide at least 2"x 2" sample.

F. Test Plan

1. Submit complete documentation of the proposed test plan and equipment to be used to document that the performance of the cabling, equipment, sub-systems and complete systems installed under the work of this project conform with the performance standards outlined in each specification section.

2. Submit not less than 45 days prior to the proposed test date. Include procedures for certification, validation, and testing.

G. Test Reports

1. Manufacturer's Field Reports

a. Factory reel tests

2. Project Site Test Reports:

a. Submit following system completion and prior to and as condition precedent to Acceptance Review and Testing of the Work of this Section.

b. Schedule: Submit test reports in timely manner relative to Project schedule such that the University's Representative may conduct verification of

submitted test data without delay of scheduled progress.

c. Project Site test report:

d. Content: Include at least:

i. Time and date of test.

ii. Personnel conducting test.

iii. Test equipment, including serial and date of calibration.

iv. Test object.

v. Procedure used.

vi. Results of test

vii. Numerical or graphical presentation.

e. Submit copy of final results on paper and in electronic form, organized by circuit number, consistent with circuit numbering scheme used in preparing submittal drawings and in labeling receptacles and terminations.

i. Submit machine-generated documentation and raw data of all test results in electronic form on CD-R media

ii. Where the electronic documentation requires use of a proprietary computer program to view the data, provide the University with 1 licensed copy of the software.

1.5 QUALITY ASSURANCE

A. Procedures: In accordance with Division 1 – Quality Control.

B. Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.

C. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.

1. A complete set of the latest stamped, actioned submittals of record.

2. A complete set of manufacturer's original operation, instruction and service manuals for each equipment item.

D. Standard Products

1. Telecommunications Equipment. Provide telecommunications materials and

equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 1 year prior to bid opening. The 1-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 1-year period.

a. Alternative Qualifications. Products having less than a 1-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 4000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

2. Audiovisual Systems Equipment. Provide Audiovisual Systems, Public Address Systems and Broadband Communications materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for six months prior to bid opening. The six month period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six month period.

a. Alternative Qualifications. Products having less than a 1-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 2500 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

3. Material and Equipment Manufacturing Date

a. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

E. Test Equipment

1. Requirements:

a. Maintain and operate test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section.

b. Maintain test equipment at the job site while work is in progress from installation of equipment racks until Owner Acceptance of this Work; thereafter remove all of this test equipment from the job site.

c. Unless otherwise indicated, test equipment shall remain property of the Contractor.

d. Provide all required test cables, jigs and adapters.

e. Provide equipment with traceable calibration, with calibration date not greater than one year prior to the date of the use of the equipment to perform the specified testing.

F. Qualifications

1. Communications Infrastructure work shall be performed by and the equipment shall be provided by the telecommunications contractor and key personnel. Qualifications shall be provided for:

    i. the telecommunications system contractor,

    ii. the telecommunications system installer,

    iii. and the supervisor (if different from the installer).

    b. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

2. Key Personnel, General

    a. Indicate the proposed key persons that are currently employed by the telecommunications contractor or who have a commitment to the low voltage systems and infrastructure contractor for the work of this project. All key persons shall be employed by the low voltage systems and infrastructure contractor at the date of issuance of this project, or if not, have a commitment to the low voltage systems and infrastructure contractor to work on this project by the date that the bid was due to the University's Representative.

    b. Note that only the key personnel approved by the University's Representative in the successful proposal shall perform work on this project's low voltage systems and infrastructure systems. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the low voltage systems and infrastructure contractor's key personnel requires approval from the University's Representative.

3. Telecommunications Contractor

    a. The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment.

        i. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

        ii. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

b. Key Personnel

i. Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this project depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

ii. Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

iii. In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this project. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this project. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity

4. Minimum Communications Infrastructure Manufacturer Qualifications

a. Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with ANSI/TIA/EIA-568-B.1, ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.3.

5. Audiovisual Systems Installer

   a. The installer of the audiovisual, public address and broadband communications systems shall be a firm regularly and professionally engaged in the business of installation, configuration and testing of the specified audiovisual systems and equipment.

      i. Where the manufacturers of the specified and contractor proposed systems provide mandatory installer and programming training programs, the Contractor's programming and installation staff shall provide documentation to demonstrate their successful completion of the relevant training programs for the types and versions of equipment proposed for installation on this Project.

      ii. Where the manufacturer of the specified and contractor proposed systems and equipment lawfully restricts sales of their equipment to a network of dealers, the contractor shall provide documentation to their standing as such a dealer in good standing at the time of bid submittal.

      iii. The audiovisual systems contractor shall demonstrate experience in providing successful audiovisual systems of a similar scope and nature of those required by the work of this Project within the past 3 years.

      iv. Submit documentation for a minimum of three and a maximum of five successful audiovisual system installations for the audiovisual systems contractor.

   b. Key Personnel

      i. Provide key personnel who are regularly and professionally engaged in the business of the installing, programming, configuring and testing of the specified audiovisual systems and related presentations and equipment.

         (1) There may be one key person or more key persons proposed for this project depending upon how many of the key roles each has successfully provided.

         (2) Each of the key personnel shall demonstrate experience in providing successful audiovisual systems of a similar nature scope and extent to those required by the work of this Project within the past 3 years.

(3) Provide specific documentation indicating that the proposed key personnel have obtained factory sponsored training and certification in the programming, configuration and adjustment of the software based controls and audiovisual systems equipment required by the work of this Project. Provide documentation demonstrating current certification of proposed personnel conforming with the requirements of this Section.

1.6 REGULATORY REQUIREMENTS

A. Regulations Applicable: Including but not limited to those defined in Division 1 - Regulatory Requirements.

1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.

2. Safety Agency Listing: All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so labeled.

3. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the University's Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.7 DELIVERY, STORAGE AND HANDLING

A. Procedures:

1. In accordance with Section 01600 – Product Requirements and as specified in the individual sections of Division 16.

B. General

1. Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

1.9 SEQUENCING

A. Comply with Division 1- Summary of Work, Division 1– Contract Schedules and the following.

1. Sequence.

a. Within 10 days of issuance of the Notice to Proceed, the University will provide the Contractor copies of the Contract Drawings showing station outlets with final University assigned backbone cable and horizontal jack and cable ID numbers in the following form.

2. Reproducible:

a. 1 set of reproducible bond.

b. CAD files: 1 set.

3. Contractor to use these numbers in preparing their shop drawings and in executing the work of the Project.

1.10 OPERATING AND MAINTENANCE DATA

A. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the low voltage systems, equipment and infrastructure work of this Project. Precede the manuals with a systems narrative specific to this Project, outlining the major systems functionality, the major systems components, and identifying which manuals document the performance of which subsystems.

1. Submit operations and maintenance data in accordance with Division 1 – Closeout Procedures, Final Cleaning and Extra Materials and as specified herein not later than 2 months prior to the date of beneficial occupancy.

1.11 PROJECT RECORD DOCUMENTS

A. Comply with Division 1 – Closeout Procedures, Final Cleaning and Extra Materials, and the following. Include at least as much information as required for the submittal drawings.

1. Record Drawings

a. Content, General

i. Contractor shall be responsible for updating building and communications plans to reflect as-built and as-installed conditions.

ii. Indicate actual work on Drawings; indicate actual products used, replace vendor neutral nomenclature used in bid set with makes and models of actual installed devices.

b. Additional Content, Telecommunications Infrastructure

i. Provide T5 drawings including documentation on cables and termination hardware in accordance with ANSI/TIA/EIA-606-A. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. Provide the following T5 drawing documentation as a minimum:

(1) Cables - A record of installed cable shall be provided in accordance with ANSI/EIA/TIA-606-A. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with ANSI/TIA/EIA-606-A. Include manufacture date of cable with submittal.

(2) Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with EIA TIA/EIA-606-A. Documentation shall include the required data fields as a minimum in accordance with EIA TIA/EIA-606-A.

c. CAD.

i. Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, latest version at time of bid. (Campus Standard, no substitution permitted).

ii. Except where prohibited by Contract, University's Representative will furnish CAD backgrounds in AutoCAD® .DWG format, for use by the Contractor in preparing Record Drawings.

iii. Disk copy of Record Drawings: Provide 2 separate disc copies of each drawing file in the format noted above. Submit on CD-R disk media.

d. Reproducibles: Provide 1 set of Mylars.

2. Software

a. Controls and DSP Systems

i. Provide licensing for project specific software programming at programmable devices.

ii. Provide licensing and original software copies for each device provided that uses software for operation, configuration or control.

iii. Provide licensing for required workstation operating systems, and required third party software.

iv. For controls systems, provide a complete copy of the source code, including the device interface driver code modules.

v. Upgrade each software package to the release in effect at the end of the Warranty Period.

b. Provide at least a copy of software with at lease 1 user license if required to view submitted test data.

3. Spare Parts

a. In addition to the requirements of Division 1– Closeout Procedures, Final Cleaning and Extra Materials, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

1.12 WARRANTY SERVICE

A. In addition to provisions of Division 1– Guaranties, Warranties, Bonds and Maintenance Contracts, provide the following.

1. Response Time: Provide a qualified technician familiar with the work at the Project Site within 24 hours after receipt of a notice of malfunction. Provide the University's Representative with telephone number attended 8 hours a day, 5 days a week, to be called in the event of a malfunction.

B. Provide all additional Warranties as defined in each Communication Systems Section.

1.13 ACCEPTANCE REVIEW AND TESTING PROCEDURES

A. Complete all Work of this Section. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, less reduced set of Record Drawings. Notify the University's Representative in writing that the Work of these Sections is complete and fully complies with the Contract Documents. Request Acceptance Review and Testing. The University's Representative will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this Work. These procedures may be performed at any hour of the day or night as required by the University's Representative to comply with the Project Schedule and avoid conflict with Residents. Provide all specified personnel and equipment at any time without claim for additional cost or time.

B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of this Section. Provide quantity of technicians as required to comply with Project Schedule.

C. In Addition, Provide:

1. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.

2. Ladders, scaffolding and/or lifts as required to access high devices.

3. All test equipment.

4. Complete set of latest stamped, actioned submittals of record for reference.

5. Complete set of Test Reports.

6. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

7. Demonstrate: Complete operation of all systems and equipment, including Portable Equipment.

8. Adjust: As directed by the University's Representative.

9. Correct: In timely manner, failure to comply with the Contract Documents, as reasonably determined by the University's Representative.

D. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the University's Representative, in place of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven (7) days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.

1.14 CLOSEOUT

A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify the University's Representative of completion of Punch List.

B. Portable Equipment: Furnish all portable equipment and spares to the University's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.

C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.

D. Project Record Documents: Submit print and digital copies. Digital files shall be in CAD system shall produce files in AutoCAD® .DWG format, latest version at time of bid. (Campus Standard, no substitution permitted) as defined above.

E. Keys: If applicable, replace construction locks with permanent locks. Provide 5 sets of keys to the University's Representative.

F. Instruction: Conduct specified instruction.

G. Warranty: Submit Warranty dated to run from date of Acceptance of the Work of this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.

B. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.

C. Products shall be made by manufacturers regularly engaged in the production of such products.

D. Provide quantity as shown on Contract Drawings, or as otherwise required for a complete and operational system.

E. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.

F. Unless recycled content is specified, provide new materials.

G. Provide the manufacturer's latest design/model, permanently labeled with the manufacturer's name, model number and serial number.

H. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated.

I. Components

1. UL or third party certified. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.

a. The label or listing by the specified organization will be acceptable evidence of compliance.

b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the University's Representative.

c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

J. Enclosures:

1. Provide steel frames and enclosures designed and wired to eliminate all induced

currents.

2. Make bolted connections with self-locking devices.

K. Finishes: Any item or component of the Work of this Section which is visible shall comply with the following.

1. Finishes noted or scheduled on the Contract Drawings take precedence.

2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless otherwise noted or directed, neatly remove or permanently paint out such logos.

3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the University's Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions before starting work. Submit conflicts in a timely manner for resolution

3.2 WIRING CLASSIFICATION AND RELATED

A. Audio Signal Wiring Classification:

1. Type A-l: Microphone level wiring less than -30 dBu, 20 Hz to 20 kHz.

2. Type A-2: Line level wiring -30 dBu to +24 dBu, 20 Hz to 20 kHz.

3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBu, from 20 Hz to 20 kHz.

B. Video and Related Signal Wiring Classification:

1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.

2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.

3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.

4. Type V-4: MATV system wiring 0.1 to 1000 microVolts peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.

C. Control Signal Wiring Classifications:

1. Type C-1: DC control wiring 0 to 50 volts.

2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.

3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.

D. Additional Wiring Classifications:

1. Type M-1: DC power wiring 0 to 48 volts.

2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.

3. Wiring Combinations:

E. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Drawings.

1. Types A-1, C-1, and M-1.

2. Types A-2, C-l, C-2, and M-l, runs less than 20 feet.

3. Types A-2, C-1, and M-1.

4. Types A-3, C-1, C-2, and M-1.

5. Types A-2, V-1, and V-3.

6. Types V-1, V-2, V-3, and C-1.

7. Types M-2 and C-3.

3.3 PREPARATION

A. Prepare and sequence the work to minimize disruption to each room environment and existing communications systems.

B. Protection: Cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.

3.4 REPAIR AND RESTORATION

A. Where working in spaces occupied by the University, return to their original positions any furniture or articles relocated to perform the work.

3.5 CLEANING

A. Where working in spaces occupied by the University:

1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.

2. All scrap material in work area shall be picked up and removed from the building at the end of each day. See also Section 01770 Closeout Procedures, Final Cleaning,

and Extra Materials for additional requirements.

3. All dust resulting from work performed shall be vacuumed up daily.

4. All scrap material shall be removed from Campus and disposed of in an authorized disposal site. Refer to Section 01738 – Construction and Demolition Waste Management for Project Procedures.

END OF SECTION 27 00 00**Error! Reference source not found.** – Communications Basic Requirements

SECTION 27 05 26

COMMUNICATIONS GROUNDING AND BONDING

PART 1 -

PART 2 - GENERAL

2.1 SCOPE OF WORK

A. Section includes grounding and bonding of Communications Work, including but not limited to:

1. Communications Raceways

2. Cable Runway

3. Cable Shields

4. Protector Fields

5. Communications cabinets and enclosures.

B. Related Work Under Other Sections

1. Section 26 05 26 – Grounding & Bonding

2. Section 27 00 00 – Communications Basic Requirements

3. Section 27 05 28 – Communications Pathways

4. Section 27 15 13 – Communications Structured Cabling, Basic Materials and Methods

5. Section 27 20 00 – Communications Termination Blocks and Patch Panels

6. Section 27 13 14 – Communications Backbone OSP Twisted Pair Cabling

7. Section 27 50 00 – Ring-Down Emergency Telephones

2.2 SYSTEM DESCRIPTION

A. Provide telecommunications system grounding conductor as described herein and indicate on drawings.

B. Except as otherwise indicated, the complete communications installation including the metallic conduits and raceways, cable trays and cable runways, boxes, pull and terminal cabinets, equipment, racks and equipment cabinets shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified.

C. Resistance:

1. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI-J-STD-607-A-2002, whichever is more restrictive.

2.3 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI/TIA/EIA-606-A-2002 Administration Standard for Commercial Telecommunications Infrastructure

2. ANSI-J-STD-607-A-2002 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

3. Underwriters Laboratories (UL)

4. UL 467 (1993); R 2004 Grounding and Bonding Equipment

2.4 SUBMITTALS

A. Conform with the requirements of Division 1 Shop Drawings, Product Data and Samples and Section 27 00 00 – Communications Basic Requirements.

PART 3 - PRODUCTS

3.1 MANUFACTURERS

A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:

1. Ground Rod:

a. High strength high carbon steel, with electrolytically bonded jacket of copper on surface

b. UL spec. 467

c. ANSI C-33.8-1072.

d. Manufacturer:

i. Allied Bolt

ii. Inwesco 12A60

iii. Blackburn

iv. Cooper Power Systems

v. Weaver.

vi. Erico "Cadweld" Products, Inc.

vii. ITT Blackburn.

viii. Or equal.

2. Ground Wells:

a. Christy Concrete Products, Inc.

b. Forni Corp.

c. Or equal.

3. Ground Bushings, Connectors, Jumpers and Bus:

a. O-Z/Gedney.

b. Thomas & Betts Corp.

c. Or equal.

4. Compression Connector Lug

a. Panduit

b. B-Line SB-479 Series

c. Thomas & Betts

d. Or equal.

5. Telecommunications Ground Bus Bar

a. CPI

b. B-Line

c. Panduit

d. or equal.

6. Rack and Cabinet Grounding

a. Panduit Structured Ground Kit

b. Chatsworth Products Inc.

c. Middle Atlantic

d. Hoffman

e. or equal.

7. Bonding Ribbon:

a. Annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated.

b. Manufacturer:

i. Inwesco 12A55

ii. Corning Cable Systems

iii. Preformed Line Products.

iv. or equal.

8. Bonding Ribbon Clamp:

a. Soft lead

b. 1/16 inch thick

c. Bolt hole for attachment

d. Manufacturer:

i. Inwesco 12A56

ii. Corning Cable Systems

iii. Preformed Line Products.

iv. Or equal.

9. Fargo Clamp:

a. Cast copper, silver plated, furnished with copper bolt.

b. RUS Listed

c. Manufacturer:

i. Allied Bolt

ii. Inwesco 12A57

iii. Corning Cable Systems

iv. or equal.

10. Ground Inserts:

a. Cast Bronze w 1/4 Copper Rod.

b. Provide minimum one each maintenance hole or vault.

c. Manufacturer:

i. Inwesco 12H69

ii. or equal by vault or manhole manufacturer.

iii. or equal.

3.2 GROUND CONDUCTORS

A. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green. Where continuous color-coded conductors are not commercially available, provide a minimum 4" long color band with green, non-aging, plastic tape in accordance with NEC.

B. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.

3.3 COMPRESSION CONNECTOR LUG

A. Description

1. Connector lug with compression connection to conductor.

2. Copper alloy body.

3. Provide lug size to match conductor being terminated.

4. Provide 2 hole pattern lugs.

5. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.

3.4 INSULATED GROUNDING BUSHINGS

A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

3.5 CONNECTIONS TO PIPE

A. For cable to pipe: UL listed bolted connection complying with CEC requirements.

3.6 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.

1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.

2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy "Hy-Ground" or equal.

3.7 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

A. Where required by the drawing or specified herein.

PART 4 - EXECUTION

4.1 GENERAL

A. Provide Grounding and Bonding according to the most restrictive requirements of:

1. ANSI-J-STD-607-A.

2. California Electrical Code Article 250 and references therein.

3. California Electrical Code Article 800 and references therein.

B. In the event of conflicting requirements, National Electrical Code requirements shall prevail.

C. Point of Connection

1. Under Work of this Section, make connections to Communications Ground Busbars provided under Work of Section 26 05 26 - Grounding and Bonding

2. Mechanical Connections

D. Make connections bare metal to bare metal.

1. Where required, remove paint to bare metal, make grounding or bonding connection, and touch up paint.

2. Torque threaded fasteners to manufacturer's recommended values.

E. Compression Connections

1. Make compression connections with the lug or fitting manufacturer's recommended tooling, with the tooling set to the recommended force and stroke.

F. Communications Raceways and Sleeves

1. Bond metallic raceway and sleeves to the Communications Ground Busbar at the Communications Room that serves the related Communications Receptacle.

2. Where a metallic raceway connects 2 or more Communications Rooms, bond to the Communications Ground Busbar at each.

G. Cable Tray and Cable Runway

1. Provide manufacturer's bonding clips, plates or jumpers as required to comply with the UL Classified conditions for use as an equipment grounding conductor.

2. Bond the Cable Runway to the Communications Ground Busbar at the Communications Room served.

H. Cable Shields

1. Comply with California Electrical Code Article 800.

I. Protector Fields

1. Comply with California Electrical Code Article 800.

J. Communications Underground Manholes, Pullboxes and Vaults

1. Provide at least one ground rod at each new Underground Manholes, Pullboxes and or Vault provided under the work of this project.

K. Communications cabinets and enclosures

1. Bond to the Communications Ground Busbar at the Communications Room.

L. Emergency/Information Telephone enclosures

1. Bond as detailed on Communications Drawings.

M. Communications Broadband Systems

1. Comply with California Electrical Code Article 820.

2. Ground Broadband passives as shown on Communications Drawings.

4.2 LABELING

A. Provide labeling according to the requirements of:

1. ANSI/TIA/EIA-606-A.

2. Section 16740 - Identification for Communications Systems.

END OF SECTION 27 05 26 - Communications Grounding and Bonding

SECTION 27 05 28

COMMUNICATIONS PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, and set up of the Communications System Raceway, Conduit and Backbone work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, contiguous working raceway systems.

B. Communications Outside Plant Ductwork - refer to the drawings for demarcation of the work of this Project.

1. Communications Outside Plant Ductwork.

2. Communications Pullboxes

1.2 RELATED WORK:

A. Related Work in Other Sections:

1. Section 03 30 00 – Cast-In-Place-Concrete

2. Section 27 00 00 – Communications Basic Requirements

3. Section 27 05 26 – Communications Grounding and Bonding

4. Section 27 13 14 – Communications Backbone OSP Twisted Pair Cabling

5. Section 27 15 13 – Communications Horizontal Twisted Pair Cabling

6. Section 27 25 30 – Identification for Communications Systems

7. Section 27 50 00 – Ring-Down Emergency Telephones

8. Section 31 23 33 – Trenching, Backfilling and Compacting

1.3 REGULATORY REQUIREMENTS

A. In addition to Regulatory Requirements, comply with the following.

1. Public Utilities Commission of the State of California.

a. Rules for Overhead Electric line Construction, General Order No. 95 inclusive of all Decisions or Resolutions thereto authorized with Date Effective up to and including 30 days prior to the bid opening day.

b. Rules for Underground Electric Line Construction, General Order No. 128 inclusive of all Decisions or Resolutions thereto authorized with Date Effective up to and including 30 days prior to the bid opening day.

1.4 REFERENCES

A. Usage: In accordance with Division 1 – Regulatory Requirements.

B. BICSI

1. Customer Owned Outside Plant Design Manual

C. American National Standards Institute (ANSI)

1. ANSI C80.1 Rigid Steel Conduit - Zinc Coated

D. State of California, Business, Transportation and Housing Agency, Department of Transportation (CalTrans)

1. Standard Specifications, latest edition.

2. Standard Plans, latest edition.

E. National Electrical Manufacturers Association (NEMA)

a. NEMA 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)

b. ANSI/NEMA FB 1 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

c. FB 2.10 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).

d. FB 2.20 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

e. NEMA FG 1 Fiberglass Cable Tray Systems

f. NEMA ICS 6 Industrial Controls and Systems Enclosures

g. NEMA RN 1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

h. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Conduit

i. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing

j. NEMA TC 6&8 PVC Plastic Utilities Duct for Underground Installations

k. NEMA TC 7 Smooth Wall Coilable Polyethylene Electrical Plastic Duct

l. NEMA TC 9 Fittings for ABS and PVC Plastic Utilities Duct for Underground Application

m. NEMA TC 14 Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings

n. NEMA TC 19 Nonmetallic Riser U-Type Guards

o. NEMA VE 1 Metallic Cable Tray Systems.

p. NEMA VE 2 Cable Tray Installation Guidelines

2. Underwriters Laboratories, Inc. (UL)

a. UL 6 Electrical Rigid Metal Conduit - Steel

b. UL 360 Liquid-Tight Flexible Steel Conduit

c. UL 514A Metallic Outlet Boxes

d. UL 514B Conduit, Tubing, and Cable Fittings

e. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.

f. UL 651 Schedule 40 and 80 Rigid PVC Conduit.

1.5 SUBMITTALS

A. Conform with the requirements of Division 1 and Section 16700 - Common Work Results for Communications.

1.6 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Division 1 – Product Requirements.

PART 2 - PRODUCTS

2.1 DUCTBANK CONSTRUCTION

A. PVC Conduit

1. Drawing and Spec Reference: PVC.

2. Construction:

a. 4" trade diameter, unless otherwise noted.

b. Poly-vinyl chloride.

c. Schedule by Application

i. Straight segments, Schedule 80.

ii. Flat elbows, Schedule 80.

iii. Vertical elbows sweep up to grade, Rigid Steel/PVC Coated.

iv. Above grade, Schedule 80.

d. Elbows.

i. Where innerduct liner is scheduled – CRSC.

ii. Elsewhere, Schedule 80.

iii. 90° C rated.

iv. Solvent welded joints, joints by pipe manufacturer.

e. Application.

i. Soil Backfill/Direct Burial

(1) RUS Type II, Type C or Type DB

(2) Schedule 40.

ii. Concrete Encasement:

(1) PVC Type DB-120,

(2) RUS Type I, Type B or Type EB

(3) Any meeting Soil Backfill/Direct Burial.

iii. Boring

(1) HDPE.

(2) RUS Type Flexible Plastic.

f. Performance:

i. Tensile Strength: 7,000 psi at 73.4° F.

ii. Flexural Strength: 11,000 psi.

iii. Compressive Strength: 8,600 psi.

g. Approvals:

i. RUS Listed for Telephone Cable Installation 5-99 Edition, or latest release thereof.

ii. NEMA TC-2, PVC Type EPC-40 and EPC-80.

iii. NEMA TC-3.

iv. NEMA TC14 Fiberglass Conduit.

v. UL 514 fittings.

vi. UL 651.

vii. ANSI C33.91.

h. Manufacturers:

i. RUS Listed:

Manufacturer	RUS Listed for	Manufacturer Part Number
Allwire, Inc.	Flexible plastic	ALLDUCT
American Pipe & Plastics	Plastic	Type B, C, and D
	Plastic	Type EB and DB
	Plastic	PVC Multi-Duct (2,3,4 and 6-way)
American International	Flexible plastic	HDPE Duct
	Plastic	PVC Type C
Apache Plastics, Inc.	Plastic	Type EB and Type DB
ARMCO	Plastic	Smooth-Cor Type B and Type C
Arnco	Flexible plastic	HDPE Conduit
Bay Plastics, Inc.	Plastic	Type B and Type C

Manufacturer	RUS Listed for	Manufacturer Part Number
Bristolpipe	Plastic	Type B, C, and D
	Plastic	Type EB and Type DB
Can-Tex	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
Carlon	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
	Plastic	Multi-Gard
Certain-Teed Products Corp.	Plastic	Type EB and Type DB
CIBA-GEIGY	Fiberglass	T & D Conduit
Condux International, Inc.	Concrete Plastic	Condux Type EB and Type DB
CSR Polypipe	Flexible plastic	HDPE Duct
Dura-line	Flexible plastic	HDPE Duct
Eagle Pacific Industries, Inc.	Plastic	Type EB and Type DB
	Flexible plastic	HDPE Coiled Duct
Endot Industries	Flexible plastic	HDPE Duct
Freedom Plastics, Inc.	Plastic	Type C
Hercules, Inc.	Flexible plastic	Corflo plastic conduit
Hurlbut Plastic Pipe	Plastic	Type C
Ingomar Plastic Pipe	Plastic	Type B and Type C
J-M Manufacturing Company	Plastic	Types C, EB, and DB
Kyova	Plastic	Type EB and Type DB

Manufacturer	RUS Listed for	Manufacturer Part Number
LCP National Plastics, Inc.	Plastic	Type EB and Type DB
	Plastic	Type B and Type C
Northern Pipe Products	Plastic	Type B, C, and D
OMNI	Flexible plastic	HDPE Duct
Petroflex	Flexible plastic	HDPE Duct
	Flexible plastic	Corrugated HDPE Duct
Phillips Products Co., Inc.	Flexible plastic	Driscon 3200
Phone Ducs	Plastic	Multiple plastic conduit (4, 6, & 9 Way)
PLEXCO	Flexible plastic	PLEXCO Duct
PWPipe	Plastic	Type EB and Type DB
Pyramid Industries, Inc.	Plastic	Type EB and Type DM
	Flexible plastic	HDPE Conduit
Quail Plastics	Plastic	Type EB and Type DB
Queen City Plastics	Plastic	Type EB and Type DB
River City Plastics	Plastic	Type EB and Type DB
Sedco	Plastic	Type EB and Type DB
Southern Pipe, Inc.	Plastic	PVC Types EB, DB, and Sch. 40
Tamaqua Cable Products	Flexible plastic	HDPE Duct
Tridyn Industries	Plastic	Type EB and Type DB
Vassallo Industries	Plastic	Type B and Type C
Wesflex	Flexible plastic	Flex-Con

ii. or equal

B. PVC Conduit, Multi-Bore

1. Drawing and Specification Reference

a. MB3x1.5; 3 cells each 1.5 inch trade size.

b. MB4x1.25; 4 cells each 1.25 inch trade size.

2. Construction:

a. Multi-cell conduit system consisting of a 4 inch trade size PVC outer shell with PVC inner ducts installed.

b. Outer duct material, performance and application as specified in paragraph "PVC Conduit" in this Section.

c. Integral bell couplings on outer and all inner ducts.

d. Inner ducts pre-lubricated.

e. Alignment marking on outer duct.

f. Manufactured system including fixed bends meeting minimum radius requirements in this Section.

3. Manufacturers:

a. American Pipe & Plastics, Inc. AMTEL series with Schedule 40 or Schedule 80 outer duct as required by application.

b. Carlon Telecom Systems Multi-Gard Type 40 or Type 80 as required by application.

c. or equal.

C. PVC Conduit, Multi-Conduit

1. Drawing and Specification Reference:

a. MC3x1.5; 3 conduits each 1.5 inch trade size

b. MC4x1.25; 4 conduits each 1.25 inch trade size

c. MC4x2; 4 conduits each 2.0 inch trade size

2. Construction:

a. PVC Schedule 80 conduits of indicated trade size, assembled into groups with factory installed spacers.

b. At least one conduit of contrasting color, or other means to identify an individual conduit within an assembled group.

c. Integral bell couplings on all conduits.

d. Manufactured system including fixed bends meeting minimum radius requirements in this Section.

e. For MC3x1.5 and MC4x1.25; available fittings to terminate into a maintenance hole or box using a standard 4.35 inch to 4.50 inch outside diameter pre-cast bell end terminator (Term-a-duct fitting).

3. Manufacturers:

a. American Pipe & Plastics, Inc. AMFO Schedule 80 system.

b. Carlon Telecom Systems Intra-Gard Type 80 system.

c. Or equal.

D. Fiberglass Conduit

1. Drawing Reference: Fiberglass

2. Construction:

a. Trade Standard Sizes

b. Meets NEMA TC 14

c. Complete system of joints and threaded steel conduit couplers

3. Manufacturers:

a. TVC Communication/Vikimatic Fiberglass Conduit

b. Champion Fiberglass

c. FRE Composite

d. Or equal.

2.2 FITTINGS

A. Couplings, adaptors, transition fittings, etc., shall be molded PVC, slip on, solvent weld type conforming to NEMA TC3 for Schedule 80 and NEMA TC 9 for type EB or DB.

B. Fitting Types

1. Expansion Fittings, 12”, Metallic:

2. Function: At road or bridge expansion joints requiring up to 12" of expansion compensation.

3. Approvals:

   a. CalTrans

4. Construction

   a. Steel, hot dip galvanized.

   b. Nylon wear bushings

   c. O-ring seal

   d. Bonding jumper

5. Manufacturers:

   a. O-Z Gedney Type AX, Type AX-8, and Type EX fittings with Type BJ Bonding Jumper.

   b. TVC/Vikimatic VB0285X series.

   c. Or equal.

C. Expansion Fittings, 6", Non-metallic:

1. Function: At road or bridge expansion joints requiring up to 6" of expansion compensation.

2. Construction

   a. Fiberglass

   b. Provide bonding jumper.

3. Manufacturers:

   a. TVC Communications HW or Extra Heavy Wall Expansion Joint.

   b. Vikimatic

   c. FRE Composites, Inc.

   d. Or Equal.

D. Caps, Underground Conduit Stubs

1. Provide at each location indicated for future expansion.

2. Watertight.

3. Manufacturers:

a. Carlon E985N

b. Arris Monarch

c. GS Industries of Basset, Inc. Expandable Watertight Plugs

d. Vikimatic

e. Or equal.

2.3 UNDERGROUND STRUCTURES

A. Vaults, PullBoxes and Manholes, Precast, General

1. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes, boxes and handholes.

2. Construction

a. General

i. Castings shall be free from warp and blow holes that may impair strength or appearance.

ii. Structures shall be precast to the design and details indicated, precast monolithically and placed as a unit, or structures may be assembled in sections, designed and produced by the manufacturer in accordance with the requirements specified.

iii. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

iv. Structure top and wall shall be of a uniform thickness of not less than 4 inches except at knockouts.

v. The minimum concrete cover for reinforcing steel shall be 2 inches.

vi. All steel, except reinforcing steel, shall be hot dip galvanized after fabrication.

vii. Knockouts & Windows

(1) Thin-walled knock-out panels designed for future duct bank entrances are permitted.

(2) Sides of precast windows shall be a minimum of 4 inches from the inside surface of adjacent walls, floors, or ceilings.

(3) Form of the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope.

(4) Provide welded wire-fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes.

(5) Provide additional reinforcing steel comprised of at least 2 No. 4 bars around window openings.

viii. Extension Rings

(1) Provide extension rings as-required to extend from finished grade to communications utilities.

ix. Bottom and Drain Sumps

(1) Provide solid concrete bottom surface.

(2) Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.

3. Joints:

a. Provide tongue-and-groove or shiplap joints on mating edges of precast components.

b. Design joints to firmly interlock adjoining components and to provide waterproof junctions, and adequate shear transfer.

c. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B.

4. Frames and Covers

a. Covers to match across all utilities.

b. Provide fiber composite lids at pedestrian rated covers, H-20 steel slip resistant covers otherwise.

c. Labeling

i. Provide labeling as follows:

(1) "UCM Communications"

(2) University's Manhole or Vault No, as shown on drawings or provided to Contractor prior to vault order placement.

ii. Labeling shall be:

(1) Cast in concrete lids

(2) Written in weld on steel lids

(3) Alternatively, for pedestrian grade vault lids and for the vault number only, provide 1/8" min. thickness lamacoid label, rivet attached to box top in recess area below surface of lid.

5. Pulling-In-Irons

a. Steel bars bent in the form indicated and cast in the walls and floors.

b. Install a pulling-in iron in the wall opposite each duct line entrance at walls, not less than 6 inches above or below, and opposite the conduits entering the manhole.

c. Pulling-in irons shall project into the manhole approximately 4 inches, or be cast in a pocket. Iron shall be hot-dipped galvanized after fabrication.

6. Cable Racks and Arms

a. Provide nonmetallic cable racks:

i. Vaults and pullboxes, Minimum two (2), at each vault face 24 inches or longer, at least one (1) each face otherwise.

ii. Manholes. Provide PTS-65 standard arrangement of cable racks at each manhole, except using nonmetallic cable rack hardware.

b. Provide non-metallic cable rack arms. Provide two nonmetallic cable racks arms - minimum 12" arms – for each cable rack provided at each manhole or vault as required above.

B. Underground Pull Boxes and Vaults, Concrete

1. Minimum Size

a. As scheduled on the drawings. Provide scheduled or larger size.

2. Lid Construction:

a. As scheduled on the plans

3. Manufacturers:

a. Brooks Products

b. Jensen PreCast

c. Utility Vault Company, Inc./Oldcastle Precast

d. Associated Concrete Products

e. Forni Corporation.

f. Or equal.

2.4 MISCELLANEOUS UNDERGROUND PRODUCTS

A. Cable Warning Tape

1. Provide

a. 6 inches wide minimum.

b. 5 mil plastic.

c. Metallic backing at least 10 feet o.c.

d. 1 mil metallic foil core.

e. Orange in color

f. Suitable for buried applications.

g. Continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" or similar at not more than 48 inch intervals.

2. Manufacturers:

a. Carlon Telecom Systems.

b. Vikimatic

c. Or equal.

B. Pull Rope

1. At least 3/8 inch diameter polyethylene.

2. 200 pound strength.

3. Manufacturers:

   a. Carlon Telecom Systems.

   b. Vikimatic

   c. Or equal.

C. Length Marked Tape

1. Provide 1/2 inch flat tape with sequential markings in whole feet.

2. Manufacturers:

   a. Carlon Telecom Systems.

   b. Greenlee

   c. Vikimatic

   d. Or equal.

D. Conduit Plugs

1. Provide universal blank duct plug type, with eye for tying rope and tape.

2. Manufacturers:

   a. Carlon Telecom Systems.

   b. Condux International, Inc.

   c. Arris Monarch

   d. GS Industries of Basset, Inc. Expandable Watertight Plugs

   e. Or equal.

E. Line Marker Post

1. Orange polyethylene, post height 4 feet above surface.

2. Soil anchor.

3. Manufacturers:

   a. Carlon Telecom Systems.

   b. Vikimatic

c. Or equal.

F. Conduit Spacer, Trench

1. Construction

a. Non-metallic.

b. Sized to snap around conduits as shown on Drawings.

c. Interlocking.

2. Manufacturers:

a. Underground Devices Wunpeece.

b. GS Industries Underground Products Spacer System.

c. Or equal.

G. Pulling In Irons

1. 7/8" Diameter

a. 6" exposed length minimum after embedment

b. RUS approved

2. Manufacturer

a. Cooper Power Systems

b. Or equal.

H. Cable Racks & Supports

1. Construction:

a. Non-metallic

b. 12" minimum rack arms

c. Snap into vertical strut sections provided with new manhole, pullboxes and vaults, or into University's existing vaults, where indicated.

2. Approvals

a. RUS

b. NEMA

3. Manufacturers:

a. Underground Devices

b. Inwesco

c. Cooper Power Systems

d. Or equal.

I. Flexible link annular sealing systems

1. Application: Watertight below grade joints of conduit and ducts into utility tunnel.

2. Suitable for use in water, direct ground burial and atmospheric conditions. Provides electrical isolation.

3. Minimum performance and construction:

a. Seal Element: EPDM (Black) or EPDM (Blue)

b. Pressure Plates: Reinforced Nylon Polymer

c. Bolts & Nuts: Steel with 2-part Zinc Dichromate & corrosion inhibiting coating.

d. Temp. Range: -40 to +250ºF.

4. Manufacturers:

a. Link-Seal Modular Seals Model “C” or “L”.

b. Or equal (no known equal).

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Refer to the most restrictive of the Code, the manufacturer's instructions, these specifications and the relevant NEMA, CalTrans or RUS guidelines and conform.

3.2 CONDUIT APPLICATION

A. General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

1. Underground Ductbanks, Concrete Encased

a. PVC

B. Exterior, Exposed:

1. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.

2. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Raintight (compression) couplers.

C. Embedded in Concrete

1. RSC or rigid non-metallic conduit.

2. PVC

D. In Utility Tunnel

1. RSC

2. CRSC

3. IMC

3.3 UNDERGROUND CONSTRUCTION:

A. Duct and Conduit Placement.

1. Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet.

2. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

3. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

B. Duct Bank.

1. Duct Entrance Arrangement - Conform to Table 3.27 and applicable arrangement diagrams 3.57-3.64 of 2004 BISCI Customer Owned Outside Plant Design Manual.

2. Terminate conduits in end-bells where duct lines enter underground structures.

3. Stagger conduit joints by rows and layers to strengthen the duct bank.

4. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per

10 feet of duct bank. Before pouring concrete or backfilling, as applies, anchor duct bank assemblies to prevent the assemblies from floating. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

5. As each section of a duct line is completed from structure to structure, for conduit sizes 3 inches and larger draw a flexible testing mandrel approximately 12 inches long with a diameter less than the diameter of the conduit through a conduit. After which, draw a stiff bristle brush having the same diameter of the conduit through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.

6. Unless otherwise noted, exterior communications conduit runs shall be buried a minimum of 24" below finished grade or as required to conform to local utility requirements. Where new trenching is required, backfill and compaction requirements shall be as defined in other Sections.

7. Where concrete encasement indicated, construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than shown. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from communications conduits by a minimum concrete thickness of 4 inches. The top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement concrete be a minimum of 24 inches below grade.

C. Where conduit runs under existing roads, cut and patch the pavement as indicated.

D. Conduit Plugs and Pull Rope. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a 3/8 inch nylon pull rope having 3 feet of slack at each end of unused or empty conduits.

E. Partially Completed Duct Banks. During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.

F. Connections to Existing Manholes. For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement.

G. Mark locations of future provision underground raceways by pre-cast reinforced concrete pullbox set flush in ground with stamped brass disk identification plate tied to conduit end with “Ty-Wrap”, “Quick-Wrap” or equal.

H. In existing facilities underground construction, the Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be brought to the immediate attention of the University’s Representative. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the University’s Representative of any such damage.

I. At twelve inches below grade, place specified warning tape continuously.

END OF SECTION 27 05 28 – Communications Pathways

SECTION 27 05 30

COMMUNICATIONS IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY:

A. Provide all labor, materials, tools, and equipment required for permanent intelligible labeling on, or adjacent to, all cabling, connectors, innerduct, faceplates, jacks, receptacles, controls, fuses, circuit breakers, patching jacks, and racks.

B. This section includes minimum requirements for the following:
1. Labeling Communications Cabling
2. Labeling Closet Hardware
3. Labeling Pathways, Spaces, Grounding and Bonding.

C. Refer to detailed plans for additional requirements.

D. Clearly and distinctly indicate the function of the item.

E. Coordinate with Record Drawings

1.2 REFERENCES:

A. Usage: In accordance with Division 1 – Regulatory Requirements.

B. American Society for Testing and Materials (ASTM)
1. ASTM D 709(2001) Laminated Thermosetting Materials

C. Electronic Industries Alliance (EIA)
1. EIA TIA/EIA-606-A(2002) Administration Standard for Commercial Telecommunications Infrastructure (ANSI/TIA/EIA-606)

D. Underwriters Laboratories (UL)
1. UL 969 (1995; R 2001) Marking and Labeling Systems

1.3 QUALITY ASSURANCE

A. Identification and administration work specified herein shall comply with the applicable requirements of:
1. ANSI/TIA/EIA – 606-A Administration Standards.
2. ANSI/TIA/EIA – 569B Pathway and Spaces
3. ANSI/TIA/EIA – 568B Telecommunications Cabling Standard.
4. BICSI Telecommunications Distribution Methods Manual.
5. UL 969 (1995; R 2001) Marking and Labeling Systems.

1.4 SUBMITTALS

A. Conform with the requirements of Division 1- Shop Drawings, Product Data and Samples and Section 27 00 00 – Communications Basic Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Division 1– Product Requirements.

1.6 SEQUENCING

A. Not Used.

PART 2 - PRODUCTS

2.1 COMMUNICATION CABLING LABELS, INTERIOR

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Provide vinyl substrate with a white printing area and black print. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.

D. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.

E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.

F. Manufacturers:

1. Cable Type – Silver Satin
   a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
   b. Brady Laser tab labels – LAT-18-361, LAT-53-361
   c. Hubbell
   d. Leviton
   e. Panduit.
   f. or equal.
2. Cable Type – 4 pair UTP
   a. Brady TLS2200 labels – PTL-31-427,PTL-32-427
   b. Brady Laser tab labels – LAT-18-361, LAT-53-361
   c. Hubbell
   d. Leviton
   e. Panduit.
   f. Or equal.
3. Cable Type – 4 pair STP
   a. Brady TLS2200 labels – PTL-21-427
   b. Brady Laser tab labels – LAT-19-361
   c. Hubbell
   d. Leviton
   e. Panduit.
   f. Or equal.
4. Cable Type – 25 pair copper
   a. Brady TLS2200 labels – PTL-21-427
   b. Brady Laser tab labels – LAT-19-361
   c. Panduit.
   d. Or equal.
5. Cable Type – 50 pair copper
   a. Brady TLS2200 labels – PTL-33-427
   b. Panduit.

c. Or equal.

6. Cable Type – 100 pair copper
   a. Brady TLS2200 labels – PTL-34-427
   b. Brady
   c. Panduit.
   d. Or equal.
7. Cable Type – 2 strand fiber
   a. Brady TLS2200 labels – PTL-19-427
   b. Brady Laser tab labels– LAT-17-361
   c. Panduit.
   d. Or equal.
8. Cable Type – 4-12 strand fiber
   a. Brady TLS2200 labels – PTL-21-427
   b. Brady Laser tab labels – LAT-19-361
   c. Panduit.
   d. Or equal.
9. Cable Type – RG-6 Coax
   a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
   b. Brady Laser tab labels –LAT-18-361, LAT-53-361
   c. Panduit.
   d. Or equal.
10. Cable Type – RG-59 Coax
   a. Brady TLS2200 labels – PTL-31-427, PTL-32-427
   b. Brady Laser tab labels – LAT-18-361, LAT-53-361
   c. Panduit.
   d. Or equal.
11. Cable Bundles
   a. Brady TLS2200 labels – PTL-12-109
   b. Panduit.
   c. Or equal.

2.2 COMMUNICATIONS CABLE LABELS, OUTSIDE PLANT

A. Cable Tags in Manholes, Handholes, and Vaults
   1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.
      a. The tags shall be polyethylene.
      b. Machine printed - Do not provide handwritten letters.
   2. Polyethylene Cable Tags
      a. Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F.
      b. Provide 0.05 inch (minimum) thick black polyethylene tag holder.
      c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
      d. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background.
      e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

3. Manufacturers:
   a. Panduit
   b. Brady
   c. Or equal.

2.3 CLOSET HARDWARE LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Where insert type labels are used provide clear plastic cover over label.

D. Manufacturer:
   1. Copper Patch Panels
      a. 4 port group
         i. Brady Laser tab labels – 2.8” x 0.375” LAT-43-707
         ii. Hubbell XPLPPA series
         iii. Leviton
         iv. Panduit.
         v. Or equal.
      b. 6 port group
         i. Brady Laser tab labels – 3.6” x 0.375”, LAT-44-707
         ii. Hubbell
         iii. Leviton
         iv. Panduit.
         v. Or equal.
      c. Individual port
         i. Brady
            (1) TLS2200 labels – 0.5” x 0.375”white, PTL-44-422
            (2) Laser tab labels – 0.5” x 0.375” white, LAT-45-707
            (3) TLS2200 labels – 0.5” x 0.375”clear, PTL-44-430
            (4) Laser tab labels – 0.5” x 0.375” clear, LAT-45-712
            (5) TLS2200 labels – 0.5” x 0.5” white, PTL-7-422
            (6) Laser tab labels – 0.5” x 0.5” white, LAT-46-707
            (7) TLS2200 labels – 0.5” x 0.5” clear, PTL-7-430
            (8) Laser tab labels – 0.5” x 0.5” clear, LAT-46-712
         ii. Hubbell
         iii. Leviton
         iv. Panduit.
         v. Or equal
      d. Patch Panel Name Label.
         i. Hubbell XOLPPID Series
         ii. Brady
         iii. Leviton
         iv. Panduit
         v. Or equal.
   2. Non-keystone based fiber patch panels
      a. Hubbell XPLFOSEPAW
      b. Brady
      c. Leviton
      d. Panduit

e. Provided with Patch Panel by the manufacturer
f. Or equal.

3. 110 blocks
   a. Brady Laser tab labels – 7.9” x 0.475” (200.6mm x 12.07mm), LAT-177-124
   b. Hubbell XPL110 series.
   c. Leviton
   d. Panduit.
   e. Or equal.

2.4 GROUNDING AND BONDING, PATHWAY, AND SPACE LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

C. Manufacturers:
   1. Brady Corporation
      a. TLS2200 labels
         i. PTL-20-422, Size 2.0” x 1.0”
         ii. PTL-22-422, Size 3.0” x 1.0”
         iii. PTL-37-422, Size 3.0” x 1.9”
         iv. PTL-23-422, Size 4.0” x 1.0”
         v. PTL-38-422, Size 4.0” x 1.0”
      b. Laser tab labels
         i. LAT-13-747, Size 1.875” x 0.833”
         ii. LAT-24-747, Size 1.75” x 1.0”
         iii. LAT-32-747, Size 3.0” x 0.9 “
         iv. LAT-33-747, Size 2.0” x 1.437”
         v. LAT-34-747, Size 3.0” x 1.437”
      c. Continuous tape for TLS2200
         i. PTL-8-422, Size 0.5” white polyester
         ii. PTL-8-430, Size 0.5” clear polyester
         iii. PTL-8-439, Size 0.5” white vinyl
         iv. PTL-42-439, Size 1.0” white vinyl
         v. PTL-43-439, Size 1.9” white vinyl
   2. Panduit.
   3. Or equal.

2.5 NAMEPLATES

A. Field Fabricated Nameplates
   1. Features/Function/Construction
      a. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.
      b. Comply with ASTM D 709.
      c. Each nameplate inscription shall identify the function and, when applicable, the position.
      d. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core.
      e. Surface shall be matte finish.

f. Corners shall be square.
g. Accurately align lettering and engrave into the core.
h. Minimum size of nameplates shall be one by 2.5 inches.
i. Lettering shall be a minimum of 0.25 inch high normal block style

PART 3 - EXECUTION

3.1 GENERAL

A. Apply labeling to clean surfaces free of oil, dust, solvents or loose material.

B. Apply after Project painting in area of application is complete.

C. Apply to locations where labeling will not be damaged, covered over or in the way of the ordinary maintenance and operation of the installed communications infrastructure or system.

D. Apply labeling right side up, parallel to major edges of surfaces to which it is applied. When no line is evident, apply parallel to floor line. Correct conditions of labeling applied out of true.

E. Protect installed labeling from damage.

F. Replace labeling that is defaced, illegible or peeling off of the surface to which it is applied.

3.2 IDENTIFICATION & LABELING

A. Pathways

1. Pathways shall be marked at each endpoint and at all intermediate pull or junction boxes. In the case of partitioned pathways (i.e. innerduct) each partition shall have a unique identifier.
2. Label pathways using the appropriate abbreviation and a number.
3. Use adhesive type labels.

B. Labels shall be affixed at the entry to all telecommunications rooms and spaces (Includes entrance facilities, communication equipment rooms, communication equipment spaces and work areas)

1. Use adhesive type labels for all communications space labeling,
2. Affix labels to entrance doors – coordinate location with University's Representative.

C. Cables

1. Horizontal and Indoor Backbone Cables shall be marked within 12” of each endpoint or to innerduct in which the cable is installed.
2. Except where installed in innerduct or conduit, all backbone fiber optic cable shall have affixed to the outer jacket, labels of a bright color that contain at least the legend "FIBER OPTIC CABLE." These labels must be affixed at separations no greater than 10 ft.
3. Within every manhole/vault/pullbox and within 4 ft of the entrance into a building

every backbone cable's assigned identifier shall be affixed to either the cable's outer jacket or to innerduct in which the cable is installed.

4. Any cable installed in conduit shall be labeled at all intermediate pull or junction boxes.
5. Label cables using the appropriate circuit ID.
6. Use adhesive type labels for all communications cable labels.
7. Affix labels to cables – marking cable is not permitted.
8. Where cable is fully encased in innerduct label the outside of the innerduct with the cable label and, where the contents are fiber optic cabling, the "FIBER OPTIC CABLE" label.

D. Patch Panels

1. Fiber patch panels shall be marked using adhesive labels indicating the range of circuits installed to it. All fiber optic cable patch panels shall be labeled with both the pair count of every fiber pair, the cable's assigned identifier, and where shown on the plans, the patch panel's assigned identifier.
2. If not shown on the Contract Documents, University's Representative will provide specific circuit ID information.
3. Category rated patch panels shall be labeled with an identifier, individual ports shall be labeled to indicate circuit and identification of station plate in which the circuit terminates.

E. 110 blocks

1. Each cable termination position on 110 blocks shall be labeled with number designators.
   a. All backbone copper cable termination blocks shall be labeled with both the pair count of every 5^{th} pair and the cable's assigned identifier.
2. Where insert type labels are used install clear plastic cover over reprinted or Laser printed type label.

F. Grounding and Bonding

1. The TMGB(s) (telecommunications main ground bar) shall be labeled as such with an adhesive type label(s) affix label(s) to TMGB.
2. The conductor connecting the TMGB (telecommunications main ground bar) to the building ground shall be labeled at each end with an affixed label in a visible location as close as practicable to the bonding point at each end of the conductor.

G. Firestopping

1. Each firestopping location shall be labeled at each location where firestopping is installed, on each side of the penetrated fire barrier, within 12 in. of the firestopping material.

END OF SECTION 27 05 30 - Communication Identification

SECTION 27 13 14

COMMUNICATIONS BACKBONE OSP TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Work of this Section includes:

1. Outdoor (Outside Plant) Communications Cabling placed underground in new and existing communications ducts between the site communications devices of this Project and the campus Telecomm Building, including:

   a. Copper cabling

2. For all cabling:

   a. Test cabling to demonstrate performance to specified standards or better using test equipment and methods as specified in Section 27 15 13 Communications Structured Cabling, Basic Materials and Methods.

   b. Label cables, jacks, plates and patch panels as specified in Section 27 05 30 – Communications Identification.

   c. Document on Record Documents as described in Section 27 00 00 – Communications Basic Requirements.

B. Related work in other Sections

1. Section 27 05 26 – Communications Grounding and Bonding

2. Section 27 05 28 – Communications Pathways

3. Section 27 05 30 – Communications Identification

4. Section 27 15 13 – Communications Structured Cabling, Basic Materials and Methods

5. Section 27 20 00 – Communications Termination Blocks and Patch Panels

6. Section 27 50 00 – Ring-Down Emergency Telephones

1.2 REFERENCES

A. Usage: In accordance with Division 1– Regulatory Requirements.

1. In addition to the requirements of Section 27 00 00 - Communications Basic Requirements and 27 15 13 – Communications Structured Cabling, Basic Materials and Methods conform to the applicable portions of the following standards agencies:

2. BICSI

   a. Customer Owned Outside Plant Design Manual, 3rd Edition.

3. Insulated Cable Engineers Association (ICEA)

   a. ICEA S-56-434 (1983, 5th Ed.) Polyolefin Insulated Communication Cables for Outdoor Use.

4. Underwriters Laboratories, Inc. (UL)

   a. UL 497 (1995, R 2001) Safety (Dec. 15, 1978, 4th Ed.; Rev. thru Oct. 9, 1990) Protectors for Communications Circuits

5. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA):

   a. RUS/REA Bulletin (Jan. 1993; Supp 1 thru 7) 1755I-100 List of Materials Acceptable for Use on Telephone System of REA Borrowers.

   b. RUS (REA) PC-2(Jan. 1978) Splicing Standard.

   c. RUS (REA) PC-4(July 1976) Acceptance Tests and Measurements of Telephone Plant.

   d. RUS (REA) PE-22(No. 1982) Aerial and Underground Telephone Cable.

   e. RUS (REA) PE-33(Mar. 1985) Shield Bonding Connectors.

   f. RUS (REA) PE-39(June 1993) Filled Telephone Cables.

   g. RUS (REA) PE-60(Sep. 1979) Trunk Carrier Systems.

   h. RUS (REA) PE-74(Oct. 1985) Filled Splice Closures.

   i. RUS (REA) PE-87(Dec. 1983) Terminating (TIP) Cable.

   j. RUS (REA) PE-89(June 1993) Filled Telephone Cable with Expanded Insulation.

   k. RUS (REA) TECM 644(Apr. 1983; Issue No.3) Design and Construction of Underground Cable (Physical Plant).

   l. RUS (REA) TECM 823(Aug. 1980; Issue No. 3) Electrical Protection by Use of Gas Tube Arrestors.

   m. SUBMITTALS

B. Conform with the requirements of Division 1- Shop Drawings, Product Data and Samples and Section 27 00 00 – Communications Basic Requirements.

1.3 DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Division 1– Product Requirements and Section 27 15 13 – Communications Structured Cabling, Basic Materials and Methods.

PART 2 - PRODUCTS

2.1 COPPER OSP CABLING

A. Telephone, Outside Plant, Underground in Ductbank

1. Features/Functions:

a. Solid round copper wire, individually bound per REA PE-39 color coded.

b. Meets RUS REA 1755.390

c. Solid aluminum tape overall shield.

d. Gel filled.

e. Polyethylene Overall Jacket.

f. Listed as approved for RUS borrowers for his application.

g. Suitable for direct burial.

h. 6 to 3000 Pair counts available.

2. Manufacturer:

a. Alcatel

b. Superior/Essex

c. General Cable

d. NORDX/CDT

e. Any meeting REA PE-39 for cable smaller than 400 pair,

f. Or equal.

B. Shield Connectors:

1. Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire.

2. The connector shall be made of tin-plated tempered brass.

3. Shield bond connectors shall comply with REA PE-33.

C. Grounding Braid:

1. Grounding braid shall provide low electrical impedance connections for dependable shield bonding.

2. The braid shall be made from flat tin-plated copper.

2.2 OUTSIDE PLANT TELEPHONE CABLING CLOSURES

A. In Building Telephone Closure:

1. Features and Functions:

a. Provides transition point from unlisted, gel-filled Outside Plant Cabling to Interior (T-IDW) cabling

b. Can house a straight, butt, and branch splice in a protective housing.

c. Not pressurized or encapsulated.

d. Fire-retardant Plastic construction, meeting PUB55006 for interior (in-building) installation.

e. RUS (formerly REA) listed for application.

f. Provide a suitable means for mounting to backboard.

2. Manufacturer:

a. UraSeal 2000FR Type.

b. 3M K&B Series

c. Or equal.

d. Outside Plant Telephone Closure, Vault

3. Drawing Reference:OTC

4. Features/Functions

a. Can house a straight, butt, and branch splice in a protective housing.

b. Rigid outer protective body

c. Suitable for periodic water immersion - air and watertight.

d. Renter able.

e. Gel Filled, Injected encapsulant using precision means

5. Manufacturer:

a. UraSeal 2200 Closure and Cable Repair System

b. 3M 900 Series Direct Injection

c. Emerson Network Power

d. Or equal.

e. Multipair Splicing Connectors

6. Drawing Reference: None. Provide at all IBTC, OTC and similar locations where shown on the plans or required in the field.

7. Function:

a. Can gas tight terminate large pair counts of copper cabling to connectorized ends and reliable mate ends in compact area.

b. Industry standard termination means.

8. Manufacturer:

a. 3M 710 (Industry standard item)

b. Or equal (no known equal).

2.3 MISCELLANEOUS UNDERGROUND PRODUCTS

A. Bonding Ribbon:

1. Annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated.

2. Manufacturer:

a. Inwesco 12A55

b. Corning Cable Systems

c. Preformed Line Products.

d. Or equal.

B. Bonding Ribbon Clamp:

1. Soft lead

2. 1/16 inch thick

3. Bolt hole for attachment

4. Manufacturer:

a. Inwesco 12A56

b. Corning Cable Systems

c. Preformed Line Products.

d. Or equal.

C. Fargo Clamp:

1. Cast copper, silver plated, furnished with copper bolt.

2. RUS Listed

3. Manufacturer:

a. Allied Bolt

b. Inwesco 12A57

c. Corning Cable Systems

d. Or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide safety barriers and flag persons for all open manholes and pullboxes that are located in areas accessible to the public.

B. Provide traffic control in accordance with the requirements of Division 1- Special Requirements.

C. Conform to OSHA guidelines when accessing manholes and handholes, inclusive of the requirement for air sampling. Provide continuous measurements. Provide the University's Representative with contractor maintained logs of air samples taken at most two hours apart.

D. Provide sufficient personnel to permit one individual to remain above the surface at all times, in visual contact with persons in manholes and similar. Provide the observer with an appropriate means of obtaining assistance.

E. Provide ladders for access to manholes. Do not permit workers to use cables or splice cases as ladders.

F. Install a 3/8" nylon pullrope with all underground cables.

3.2 CABLE PULLING.

A. Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables.

B. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation.

C. Use flexible cable feeds to convey cables through manhole opening and into duct runs.

D. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop.

E. Maintain minimum allowable bending radii in forming such loops.

F. Do not exceed the specified cable bending radii when installing cable under any conditions, including turn-ups into outdoor pedestals or other enclosures.

G. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable.

H. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.3 CABLES IN MANHOLES, PULL BOXES AND HANDHOLES.

A. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths.

B. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators.

C. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, locate the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported.

D. Splicing:

1. Refer to Section 27 15 13 – Communications Structured Cabling, Basic Materials and Methods.

2. Support cable splices in underground structures by racks on each side of the splice.

3. Located splices to prevent cyclic bending in the spliced sheath.

E. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as otherwise indicated for existing installations.

3.4 SERVICE LOOP AND TRANSITION SPLICE AT BUILDING ENTRY

A. For outside plant, flooded cables of 100 pair or greater entering a Building Distribution Facility or Entrance Facility, provide a transition in a splice case, Type IBTC, to non-flooded cable prior to termination on the protector blocks. Unless otherwise indicated on the plans, position the splice case high on the backboard, parallel to the floor at location suitable for service and where gel will not be drawn from the serving outside plant cabling into the IBTC.

B. At IDF's and BDF's, at both ends of cables, provide at least 20 feet of cable in excess of that required to reach the protectors or terminal block by a dressed route. Form into a storage loop, typically around the perimeter of the backboard and fix in place as directed by the University's Representative.

C. Refer to Section 16780 - Communications Indoor Backbone Cabling for additional requirements for termination within IDF's, BDF's and Telecommunication Building.

END OF SECTION 27 13 14 – Communications Backbone OSP Twisted Pair Cabling

SECTION 27 15 13

COMMUNICATIONS STRUCTURED CABLING, BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section defines commons means and methods for the work of the following Sections:

1. Section 27 00 00 – Communications Basic Requirements

2. Section 27 20 00 – Communications Termination Blocks and Patch Panels

3. Section 27 13 14 – Communications Backbone OSP Twisted Pair Cabling

1.2 RELATED DOCUMENTS

A. Section 27 00 00 – Communications Basic Requirements applies to the work of this Section.

1.3 REFERENCES

A. Usage: In accordance with Division 1– Regulatory Requirements.

B. In Addition to the requirements of Section 27 00 00 – Communications Basic Requirements, conform to the applicable portions of the following standards agencies:

1. American Society For Testing and Materials (ASTM)

a. ASTM A228/A228M-02 Steel Wire, Music Spring Quality.

2. Bellcore

a. TR-NWT-000253Intermediate Reach, 1,OC3

3. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) Telecommunications Industry Association/Electronic Industries Association (TIA/EIA)

a. TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements (ANSI/TIA/EIA-568-B.1-2001)

b. TIA/EIA-568-B.1-1 Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 1 - Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius (ANSI/TIA/EIA-568-B.1-1-2001)

c. TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components

(ANSI/TIA/EIA-568-B.2-2001)

d. TIA/EIA-568-B.3 Optical Fiber Cabling Components Standard (ANSI/TIA/EIA-568-B.3-2000)

e. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces.

f. EIA TIA/EIA-606-A(2002) Administration Standard for the Telecommunications Infrastructure (ANSI/TIA/EIA-606)

4. Federal Communications Commission (FCC)

a. The Code of Federal Regulations, Title 47, Telecommunications, Chapter 1 - FCC Part 68 (latest revision) (47 CFR 68) .

5. Institute of Electrical and Electronic Engineers

a. IEEE 383-2003 Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations

b. IEEE 100-00 The Authoritative Dictionary of IEEE Standards Terms

6. Insulated Cable Engineers Association (ICEA)

a. ICEA S-56-434 (1983, 5th Ed.) Polyolefin Insulated Communication Cables for Outdoor Use.

b. ICEA S-83-596(latest revision) Fiber Optic Premises Distribution Cable

c. ICEA S-90-661(latest revision) Category 3, 5 and 5e Individually Unshielded Twisted Pair Indoor Cables With or Without Overall Shield for use in General Purpose and LAN Communications Wiring Systems – Technical Requirements

7. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. NEMA WC 63.1(latest revision) Twisted Pair Premise Voice and Data Communications Cables

8. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

a. NFPA 70 National Electrical Code

9. Underwriters Laboratories, Inc. (UL)

a. UL 444(2002; Bul. 2002, 2003) Communications Cables

b. UL 910(latest revision) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air

c. UL 1286(latest revision) Office Furnishings

d. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords.

e. UL 1666(latest revision) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

f. UL 1863(latest revision) Communications Circuit Accessories

1.4 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in

1. EIA TIA/EIA-568-B.1,

2. EIA TIA/EIA-568-B.2,

3. EIA TIA/EIA-568-B.3,

4. EIA TIA/EIA-569-B,

5. EIA TIA/EIA-606-A and

6. IEEE Std 100 and

7. in this Section.

B. Campus Distributor (CD) - A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

C. Building Distributor (BDF) - A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

D. Floor Distributor (FD) - A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

E. Telecommunications Room (TR) - An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

F. Entrance Facility (EF) (Telecommunications) An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

G. Entrance Room (ER) (Telecommunications) - A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

H. Open Cable - Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

I. Open Office - A floor space division provided by furniture, movable partitions, or other means instead of by building walls.

J. Pathway - A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.5 SUBMITTALS

A. Conform with the requirements of Section 01334 - Shop Drawings, Product Data and Samples and Section 27 00 00 – Communications Basic Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Division 1– Product Requirements, Section 27 00 00 – Communications Basic Requirements and the following:

B. Shipping Conditions:

1. All cable shall be shipped on reels or manufacturer supplied “handy boxes”.

2. The diameter of the drum shall be at least 13 times the diameter of the cable.

3. The reels shall be substantial and so constructed as to prevent damage during shipment and handling.

4. Secure the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.

5. Project the inner end of the cable into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

6. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable.

C. Storage:

1. Retain factory cable protection until installation. Supplement with heavy gauge plastic sheeting if factory protective membrane is pierced prior to installation. Tape ends and seams water and dust tight.

2. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent.

3. Protect cable reels from physical damage from site construction vehicles or from

settling into the soil.

4. Equipment, other than cable, to be delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.7 SEQUENCING

A. Not Used.

1.8 PERFORMANCE STANDARDS

A. Telephone (Voice) Copper Cabling Plant:

1. Suitable for direct connection to the Public Switched Network in accordance with rules set forth by FCC Part 68, California Public Utilities Commission, and other Authorities Having Jurisdiction.

2. Category 3 as defined in TIA/EIA-568-B.2 paragraph 4.4.

1.9 TESTING

A. General

1. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.

2. Test each end to end cable link.

3. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and University's Representative approved, forms; and in electronic format approved by the University's Representative.

4. Provide machine-generated data on an appropriate disk media (CD-ROM CD-R format) to be transferred to the University's computers.

a. Where the machine-generated documentation requires use of a proprietary computer program to view the data, provide the University with 1 licensed copy of the software.

5. Provide registered testing software used for the actual tests to the University for review of test data.

B. Test Equipment:

1. Provide in conformance with the applicable requirements of 27 00 00 – Communications Basic Requirements.

2. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:

a. Level II Category 5e or Cat. 6 Cable Pair Tester – Fluke/Microtest , Agilent or equal.

b. Outside Plant Voice Cabling Plant tester - capable of detecting shorts, opens, reversals, mis-wiring and crosstwists. (Siemon STM-8, Fluke or equal).

c. Tone Test Sets.

d. Site portable communications systems (walkie-talkie, cell phone or similar).

e. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

C. Station Wiring, General

1. Test station wire only after all pairs of station wire in an work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.

2. Correct any and all transpositions found. Retest.

3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced, and re-tested.

D. Inside Category 5e Cabling.

1. Using the listed Category 5e cable test set, test and submit report on the parameters specified for Category 5e cabling in this Section. Report whether tested link passes or fails the Category 5e standards in Part 2 of this Section.

2. Note exceptions to required Category standards. Remedy and retest.

E. Telephone: Outside Plant, Inside Riser Wire:

1. General:

a. A new cable shall be tested only after all wires within the cable have been terminated at both ends.

b. For unshielded cable, "measurements to ground" means an electrical connection to the Telecommunications Ground Bus, building steel, electrical metallic conduit or a water pipe.

c. The Contractor shall correct all defects possible.

d. If the maximum number of unrepairable defective pairs exceeds 4% of the cable's pair count, the cable shall be deemed unacceptable and shall be replaced. Replace, re-terminate and retest new cable at no additional cost to the University.

2. Test procedures:

a. TEST #1 – Continuity:

i. Meter set for 20 ohm full scale ohm reading. Each pair shall be shorted at one end and the loop resistance value read at the other.

ii. The difference between the largest and the smallest resistance reading from each pair in the cable shall be no more than 10 percent of the largest reading.

b. TEST #2 - Balance, Polarity and Conductor Transpositions:

i. Upon passing Test #1, the tester at one end of cable shall ground tip side of each pair in turn. The tester at other end of cable reads resistance to building ground of same conductor.

c. REQUIREMENT: Reading for each tip conductor in pair of approximately one-half the loop resistance value from Test #1.

3. Test Report:

a. Submit Test Report. Documentation shall include loop resistance regarding any opens, shorts, transpositions found, as well as corrective action taken to correct any found opens, shorts, or transpositions.

PART 2 - PRODUCTS

2.1 COMMUNICATIONS CABLES AND RELATED

A. General:

1. Cabling shall be UL listed for the application and shall comply with EIA TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3 and NFPA 70.

2. Ship cable on reels and/or in boxes bearing manufacture date for UTP in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

3. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.

a. At plenums, provide type CMP or OFNP cabling.

b. At risers, provide type CMR or OFNR cabling

c. At horizontal wiring conditions, provide type CM or OFN cabling.

4. Refer to Section 16785 - Communications Outside Plant Backbone Cabling for underground cabling installation.

PART 3 - EXECUTION

3.1 GENERAL

A. All system cabling and terminations be installed in accordance with the manufacturer's instructions and as shown.

B. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.

C. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.

D. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

E. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

F. Correct unacceptable wiring conditions including but not limited to:

1. Deformed, brittle or cracked insulation.

2. Torn or worn cable jacket.

3. Excessively scored cable jackets.

4. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.

5. Ungrommeted, unbushed, or uninsulated wire or cable entries.

6. Deformation or improper radius of wire or cable.

3.2 SPLICING

A. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

1. At designated splices, maintain conductor color code across all splices.

a. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.

b. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

B. Backbone Copper Cabling

1. At interior: Provide splice free cabling between communications rooms, and from communications rooms and all locations in the same building indicated for fiber cabling media.

2. At outside plant: Do not splice at exterior unless splicing is indicated on Plans or is unavoidable due to either cable length exceeding the maximum commercially available in the indicated strand count, or due to on-site pulling conditions. In either condition, provide documentation of the condition to the University's Representative for review prior to proceeding. If the University's Representative concurs that the conditions warrant the splice:

   a. Splice only within manholes or utility tunnel.

   b. Provide specified multipair splices assembly.

   c. Protect the splice in an OTC splice case fastened to a pair of cable rack arms.

   d. Document the installed splice case on the record drawings.

C. Fiber Optic Cabling

1. At interior: Provide splice free cabling between communications rooms, and from communications rooms and all locations in the same building indicated for fiber cabling media.

2. At outside plant: Do not splice at exterior unless splicing is indicated on Plans or is unavoidable due to either cable length exceeding the maximum commercially available in the indicated strand count, or due to on-site pulling conditions. In either condition, provide documentation of the condition to the University's Representative for review prior to proceeding. If the University's Representative concurs that the conditions warrant the splice:

   a. Splice only within manholes or utility tunnel.

   b. Provide fusion splices.

   c. Protect the splice in a FOSC fiberoptic splice case fastened to a pair of cable rack arms.

   d. Document the installed splice case on the record drawings.

D. Splicing, where required due to field pulling conditions and/or cable length limits, shall be provided at no additional cost to the University.

3.3 PULLING IN

A. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.

B. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.

C. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

D. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

E. Seal all underground conduit/ducts entering buildings and used by the work of this project watertight after cable testing, and acceptance.

3.4 SUPPORT

A. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

B. Separation; Conform to the following table with respect to separation from power and radio frequency (RF) sources. Provide at least twice the listed separation at fluorescent light fixtures, ballasts and similar high intensity Electromagnetic Field sources, including but not limited to motors, transformers and copiers.

Separation of Telecommunications Cabling and Pathways from 480 V or Lower Power Lines			
Condition	Minimum Separation Distance		
	< 2 kVA	2-5 kVA	> 5 kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.	5 in.	12 in.	24 in.
Unshielded power lines in proximity to a grounded metal conduit pathway.	2.5 in.	6 in.	12 in.
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway.	N/A	3 in.	6 in.

C. Support: Provide support for all cabling. Conform to the restrictions of the California Electric Code.

END OF SECTION 27 15 13 – Structured Cabling, Basic Materials & Methods

SECTION 27 50 00

RING-DOWN EMERGENCY TELEPHONES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes permanently installed telephone instruments.

1. Emergency Bluelight Telephone Tower

B. Related Sections

1. Division 1– Cast-In-Place Concrete

a. Provides foundations for Telephone Tower instruments.

2. Section 26 05 00 – Basic Electrical Requirements

a. Provides Class 1 power to Telephone Tower instruments.

3. Section 26 05 26 – Grounding and Bonding

a. Provide grounding at bonding of Telephone Tower

4. Section 27 00 00 – Communications Basic requirements

a. Applies to Work of this Section.

5. Section 27 05 26 – Communications Grounding and Bonding

a. Provides grounding of telephone tower instruments

6. Section 27 05 30 – Communications Identification

a. Defines labeling requirements for the Work of this Section.

7. Section 27 20 00 – Communications Terminal Blocks and Patch Panels

8. Section 27 13 14 – Communications Backbone OSP Twisted Pair Cabling

C. Related Work by the University

1. Activation of telephone circuit serving the Structured Cabling provided under the work of this Project from the Telephone Tower to the Telecommunications Building.

2. Provision and cross connection to existing campus emergency announcement system to the amplified speaker system provided with the emergency telephone unit provided under the work of this Project.

1.2 REFERENCES

A. Usage in accordance with Division 1– Regulatory Requirements.

B. Code of Federal Regulations (CFR)

1. Part 68, Federal Communications Commission

1.3 SUBMITTALS

A. Procedures

1. Division 1- Shop Drawings, Product Data and Samples

2. Section 27 00 00 – Communications Basic Requirements

B. Product Data

1. Submit for each separate product.

C. Installation Instructions

1. Submit for each separate product.

D. Shop Drawings

1. Detail drawings of foundation for Telephone Tower.

2. Area of Refuge Communications System

a. Mounting Details

b. Rough-In

c. Elevations

1.4 DELIVERY, STORAGE AND HANDLING

A. Procedures

1. Division 1– Product Requirements

2. Section 27 00 00 – Communications Basic Requirements

3. Section 27 15 13 – Communications Structured Cabling, Basic Materials and Methods

PART 2 - PRODUCTS

2.1 INSTALLED TELEPHONE INSTRUMENTS

A. Telephone Instrument, Emergency Tower (Blue Light)

1. Provide complete assembly consisting of

   a. Telephone instrument

   b. Tower with integral faceplate light, blue dome light and strobe light.

2. Telephone Instrument

   a. Emergency Telephone.

   b. Outdoor-rated.

   c. Operational in temperatures from plus 4 degrees F to 140 degrees F.

   d. Vandal resistant construction.

   e. Hands-free speakerphone.

   f. ADA-compliant.

   g. Faceplate, chassis and back box constructed of stainless steel.

   h. Signage of cast metal with text EMERGENCY in English capital letters and Braille both raised approximately 0.10 inches.

   i. Text EMERGENCY and operating pushbutton shall be color red.

   j. Provide Light Emitting Diode (LED) labeled LIGHT ON INDICATES CALL RECEIVED for hearing impaired signaling. LED to illuminate when calling party may speak (when called party is silent).

   k. Unit shall operate for emergency calling using telephone line power (Central Office Battery) or AC mains power with integral battery backup.

   l. Units that require the presence of AC mains power to operate the emergency calling function shall not be accepted.

   m. If unit is not telephone line powered, provide battery backup for a minimum of 16 hours of continuous talk time at 110 degree F ambient temperature.

   n. Unit appears as an analog telephone set to the University PBX and/or analog Centrex circuits.

   o. Dual Tone Multi-Frequency (DTMF) dialing.

   p. Call timer programmable from 1 minute to at least 24 hours.

   q. Unit programmable with 2 different telephone numbers of up to 18 digits each including pauses.

   r. If first called number is busy or does not answer, unit shall automatically

call the second programmed number. If that number is busy or does not answer, unit shall call the first number again. Cycle shall continue until the call is answered or the call timer limit is reached.

s. Programming shall be stored in non-volatile memory. Removal of telephone line power shall not cause loss of memory.

t. Comply with Code of Federal Regulations (CFR) Part 68, Federal Communications Commission.

u. Provide auto-answer.

v. Disconnect when call is complete.

w. Provide auxiliary contacts to operate strobe in Tower for the duration of a call.

3. Emergency Notification Features

a. Broadcast Audio: Four 40 watt concealed speakers (one in each direction) with 100 watt amplifier installed internal to emergency telephone assembly and connected to the University's existing broadcast audio head end using outside plant structured cabling installed under the work of this project with final cross connection to the existing system provided by the University's contractor.

4. Tower

a. Dimensions as indicated on the Drawings.

b. Construction of 0.25 inch thick carbon steel.

c. Color: Safety Blue - 11SF.

d. Vertical text EMERGENCY on each of 4 faces in white reflective capital letters, each letter at least 3 inches high.

e. Blue light and strobe in protective acrylic housing at top of tower.

f. Blue light LED light source, 4 watt, 50,000 hours, 209 lumens peak, 60 flashes per minute

g. Strobe activated when EMERGENCY button is pressed and flashes for the duration of the call.

h. Telephone instrument faceplate lighting, continuously lit, 2 watt, 50,000 hour LED light source.

i. Power requirements approximately 3 amps at 120 volts AC for strobe operation.

j. Mounts to concrete foundation.

5. Manufacturer

a. Talk-a-Phone Company WEBS-MT/R Radius Emergency Phone Tower with ETP-400 Single Button Emergency Phone. Color: Safety Blue - 11SF. (Campus Standard, no substitution permitted.)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's Installation Instructions and Large Scale Layout Drawings as submitted, with review action "No Exception Taken".

B. Program automatic dialing devices as directed by the University's Representative.

3.2 TESTING

A. Demonstrate complete operation of each separate telephone instrument.

B. Correct all non-conforming conditions.

END OF SECTION 27 50 00 – Ring-Down Emergency Telephones

SECTION 31 10 00- SITE CLEARING

PART 1- GENERAL

1.1 DESCRIPTION

A. Furnish labor, material and equipment required for the removal of surface debris, removal of trees, shrubs and other plant life, where indicated on the Drawings; remove temporary structures, miscellaneous debris in and around structures to be demolished; remove appurtenances and abandoned utilities; remove brush, trash, salvage and debris resulting from clearing; remove paved asphalt concrete areas. Include stripping and stockpiling of topsoil, and dust control.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Perform Work, including disposal of debris, in accordance with rules and regulations of State and local agencies having jurisdiction. Comply with Section 01 35 40 Environmental Mitigation.

1.3 SUBMITTALS

A. Conform to the requirements of Section 01 33 23 Shop Drawings, Product Data and Samples for submittal procedures.

B. Product Data: Provide data for Products specified.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Project Record Documents: Record actual locations of pipe mains, valves, connections, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.4 SURROUNDING SITE CONDITION SURVEY

A. Prior to commencing the Work, Contractor, and University's Representative shall tour the Project site together to examine and record damage to existing adjacent buildings, campus streets, bicycle paths, sidewalks, and all other improvements. This record shall serve as a basis for determination of subsequent damage due to Contractor's operations and shall be signed by all parties making the tour. Any cracks, sags, or damage to the adjacent buildings and improvements not noted in the original survey, but subsequently discovered, shall be reported to the University's Representative.

1.5 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. The Drawings show existing above and below grade structures, drainage lines, storm drains, sewers, water, gas, electrical, hot water, steam, condensate and other utilities that are known to the University in their approximate location. The Contractor shall exercise care in avoiding damage to these facilities. The Contractor will be held responsible for the repair if

damaged. The University or University's Representative does not guarantee that all utilities or obstructions are shown or that the locations indicated are accurate.

B. Locate and surface mark (various colors specified by USA) all known existing underground structures and utilities before proceeding with construction operations that may damage them. Stake and flag utility valve boxes and other surface structures. Prior to commencing excavation and trenching, coordinate with Underground Service Alert (USA North/1-800-227-2600 or 811) for field verification and marking of utilities within limits of Project site. Provide USA notification permit number to University's Representative prior to starting site Work. Existing underground structures and utilities shall be kept in service unless approval to interrupt or shutdown service is obtained from University's Representative. If damaged, the utility shall be repaired with no adjustment of Contract Sum or Contract Time.

C. Contractor shall uncover, prior to any earthwork for new construction, all existing piping where crossings, interferences, close proximity (5 feet or less) or connections are shown on the Drawings, from 1 foot below proposed construction limit to the existing ground surface. Any variation in the actual elevations and the indicated elevations shall be brought to the University's Representative's attention. If the Contractor does not expose all existing utilities, Contractor shall not be entitled to additional compensation for Work necessary to avoid interferences.

D. If interferences occur at locations other than the general locations shown on the Drawings, and such utilities are damaged before their locations have been established, or create an interference, the Contractor shall notify the University's Representative and a method for repairing the damage or correcting the interference shall be supplied by the University's Representative. Payment for additional Work due to interferences not shown on the Drawings shall be in accordance with the General Conditions.

E. Care shall be exercised to prevent damage to adjacent facilities including walks, streets, curbs, and gutters from settlement, lateral movement, undermining, and washout and other hazards; where equipment will pass over these obstructions suitable planking shall be placed. Damaged facilities, due to the Contractor operations, shall be removed and replaced at the Contractor's expense.

F. If any other structures or utilities are encountered, request University's Representative to provide direction on how to proceed with the Work.

G. If any structure or utility is damaged, take immediate action to ensure the safety of persons and property. Correct damage immediately. Contractor shall bear all costs of correction, replacement, repair, restoration, including related damages additional testing, inspection, and compensation for University’s Representatives services and expenses. Compensation to the University shall be made by deductive Change Order.

H. No Work is to be performed on energized electrical equipment unless scheduled with the University's Representative. The University reserves the right to specify specific conditions for all Work involving energized high-voltage electrical equipment.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Herbicide: Surflan, Chipco, Ronstar G, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: Verify existing conditions at the site and include all work evident by site inspection whether or not shown on the Drawings.

3.2 PREPARATION AND COORDINATION

A. Notify University's Representative before starting Work and comply with University requirements.

B. Do not close or obstruct roadways, sidewalks or hydrants without University's Representative's approval.

C. Tree Protection: Tree and plant protection shall be in accordance with Section 01 56 39 Tree & Plant Protection. Trees identified by the University's Representative for relocation shall be removed and turned over to the University, at a location identified by the University's Representative.

3.3 SITE CLEARING

A. Conduct clearing with minimum interference to public and private access. Maintain egress and access from adjacent structures at all times.

B. Clear the site within the limits shown and remove all pavement, trees, shrubs, remaining brush, stumps and waste material that would interfere with construction operation, except as specifically indicated otherwise on the Drawings, or identified by the University's Representative.

C. Apply an approved herbicide to remaining roots over 1 1/2 inches in diameter.

D. In areas not to be further excavated, fill depressions resulting from site clearing. Place and compact satisfactory soil materials in accordance with the Geotechnical Report.

E. Clear undergrowth and deadwood without disturbing subsoil.

F. Pollution and Dust:

1. Comply with Section 01 35 40: Environmental Mitigation.

2. Conduct operations so as to prevent windblown dust and dirt from interfering with adjacent property's normal operations.

3. Wet down dirt areas by spraying as required to prevent dust from becoming airborne.

G. Assume liability for all claims related to windblown dust and dirt.

H. No burning on University property.

3.4 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the applicable provisions of Section 01 35 43 Hazardous Materials including, but not limited to:

1. Separate packaging materials by type and place in locations designated by the Contractor.

2. Place unused scrap material in locations designated by the Contractor.

END OF SECTION 31 10 00-SITE CLEARING

SECTION 31 22 00- EARTHWORK

PART 1- GENERAL

1.1 DESCRIPTION

A. Section Includes:

1. Rough Grading of site, Excavating, backfilling and grading, as required to obtain contours and elevations indicated on the Drawings.

2. Subgrade preparation for pavement areas.

B. Related Sections:

1. Section 01 35 40 Environmental Mitigation

2. Section 01 57 23 Storm Water Pollution Prevention.

2. Section 31 10 00 Site Clearing.

3. Section 31 23 33 Trenching and Backfilling.

1.2 REFERENCES

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 1997.

B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2000a.

C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.

D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2000.

E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994.

F. ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates; 1995.

G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 1996.

H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 1996.

I. Geotechnical Investigation for site by Kleinfelder is available in accordance with Information Available to Bidders:

Geotechnical Investigation Letter
North Bowl Parking Lot Phase 2
University of California, Merced
5200 North Lake Road
Merced, CA
Project Number: 906550
May 20, 2015

1.3 DEFINITIONS

A. Excavation: Earth excavation includes excavation of pavement and other obstructions visible on the ground surface; underground structures, utilities and other items to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

B. Subgrade: Previously undisturbed material prepared, and compacted to required density and elevation to support a structure, or pavement system.

C. Subbase: Compacted layer of approved material used between the subgrade and the pavement.

D. Earth Excavation: Materials not otherwise defined as rock excavation including removal and disposal of pavements, visible on grade obstructions, underground structures, utilities and other items indicated to be removed.

E. Unauthorized Excavation: Includes removal and disposal of material beyond subgrade elevations, and dimensions indicated without prior approval of the University's Representative.

F. Standard Specifications: Refers to the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation (Caltrans), latest edition. In case of conflict between the Standard Specifications and these Specifications, the strictest Specifications shall govern.

1. Provisions for measurement and payment specified within the Standard Specifications shall be disregarded and the provisions of this Agreement shall govern.

G. Relative Compaction: Ratio, expressed as a percentage of field dry density as compacted to a maximum dry density of representative sample of the same material determined by ASTM D1557.

1.4 SUBMITTALS

A. Conform to the requirements of Section 01 33 23 Shop Drawings, Product Data and Samples for submittal procedures.

B. Product Data: Provide data on Products specified.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Project Record Documents: Record actual locations of pipe mains, valves, connections, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

F. Deliver samples of import backfill materials to University's Representative in quantities sufficient for testing. Deliver at least 15 days prior to use.

G. Submit a Confined Space Emergency Plan in accordance with Section 01 41 00 Regulatory Requirements prior to any personnel entering trenches or excavations greater than 5 feet in depth.

H. Dewatering Plan: If dewatering is required based on the site surface and subsurface conditions, including available geotechnical and hydrological data, Contractor is required to perform the following:

1. Lower the ground water level below the bottom of the sub excavation area.

2. Relive the hydrostatic pressure below the subgrade to prevent uplift.

3. Prevent surface drainage from accumulating within work area.

4. Legally discharge and dispose of excess water.

5. Submit description of basic components of proposed dewatering system and its planned method of operation to the University prior to dewatering operation.

1.5 QUALITY ASSURANCE

A. Testing and Inspection Service: University will engage soil testing and inspection service, for quality assurance testing during earthwork operations.

1.6 DELIVERY, STORAGE AND HANDLING

A. Stockpile satisfactory excavated materials in approved location, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Do not store soil within drip line of trees indicated to remain.

1.7 PROJECT CONDITIONS

A. Subsurface Conditions: Contractor responsibility to determine the exact nature and extent of subgrade conditions.

1. Subgrade and geotechnical information provided by the University shall not relieve the Contractor of responsibility for being familiar with the character and extent of subsurface conditions that may be encountered during performance of the Work.

B. Do not use explosives.

C. The Contractor shall assess and evaluate all site conditions and layout the work before any earthwork shall begin.

D. Contractor to provide dewatering operations

1.8 MAINTENANCE

A. Repair settlement at excavated areas for a period of one year following final acceptance at no additional cost to University. Remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment; restore appearance, quality, and condition of surface and finish to match adjacent work, and eliminate evidence of restoration.

1.9 WARRANTY

A. The Contractor shall warrant the Work against settlement for a period of one year after the date of final acceptance, and shall repair damage caused by settlement within that time. For the purpose of this Specification, settlement will be deemed to have occurred if on paved surfaces, depressions greater than 3/8 inch occur relative to paved surfaces outside the excavation area.

PART 2- PRODUCTS

2.1 MATERIALS

A. Fill Materials: Use only suitable fill except where sand is required. Do not use water saturated soil material or contaminated material.

B. On-site soils are considered suitable for use in engineered fill material, provided that they are at a workable moisture content and free of significant concentrations of organic materials, rubble or debris. Fill in the western third of the project site is currently occupied by undocumented fill ranging from approximately 0 to 12 feet in depth. The fill in this area contains some debris that will need to be removed in order to be used as engineered fill. The middle third is occupied by a temporary parking lot with approximately 8 to 12 inches of aggregate base underlain by 0 to 10 feet of undocumented fill. The eastern third is occupied by approximately zero to 20 feet of undocumented fill. The fill material in the middle and eastern thirds are generally free from debris on the surface. However, any debris that is encountered should be removed before using as engineered fill.

C. If imported material is required for fill and backfill, the imported material must be granular soil, free of organic matter, which does not exhibit excessive shrinkage or swelling behavior

when subjected to changes in water content. Imported fill shall contain no environmental contaminants or construction debris. The material shall conform to the following:

1. Have 100 percent pass through a 3 inch sieve, 95 to 100 percent pass through a 1 inch sieve.

2. Be thoroughly compacted without excessive voids.

3. Have a maximum Plasticity Index of 15.

4. Have an Expansion Index less than 20.

PART 3- EXECUTION

3.1 PREPARATION

A. Excavate by hand within drip-line of trees to remain. Do not damage trees or roots, prevent dehydration of exposed roots. Refer to Section 01 56 39 Tree & Plant Protection for additional requirements.

B. Surfaces to receive fill and soils to be compacted shall be free of standing water, and shall not be saturated with water.

C. In asphalt concrete paved areas, neatly saw cut pavement 12 inches beyond the limits of excavations. If edge of pavement is located within 30 inches of limit of excavation, remove pavement to existing edge.

D. Complete clearing and stripping as indicated in Geotechnical Report and in accordance with Section 31 10 00 Site Clearing.

E. Remove existing utility lines that traverse the site as indicated on Drawings and in accordance with Section 31 10 00 Site Clearing.

F. Scarify and compact the upper 12 inches of the exposed subgrade-to-receive fill to at least 90 percent relative compaction, but not more than 95 percent per soils report.

3.2 EXCAVATION

A. Additional Excavation: When excavation has reached required subgrade elevation shown on Drawings, notify University's Representative who will inspect conditions. When unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and place excavated material as directed by the University's Representative.

B. Stability of Excavations: Comply OSHA regulations for slope requirements. Provide shoring and bracing where required slope cannot be maintained.

C. Excavation for Pavements: Cut surface under pavements to comply with pavement section shown on Contract Documents.

D. Coordinate excavation, preparation and backfill with Work of related Sections for Project Site utilities, drainage and irrigation systems.

E. Replace the excavated material or any approved supplementary import material per the soils report.

F. The upper 12-inches of fill within building pads and concrete flatwork areas shall be per the project geotechnical report.

G. Perform footing excavations after fill placement is complete.

3.3 COMPACTION

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification as indicated below.

B. Percentage of Maximum Density Requirements: Compact soil to no less than the following percentages of maximum density in accordance with ASTM D 1557.

1. Lawn or Unpaved Areas: Compact to 85% per soils report.

2. Vehicular pavements: Compact subgrade soils to at least 90% but not more than 95% R.C. per soils report.

C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

1. Remove and replace or scarify and air dry soil material that is too wet to permit compaction to specified density.

2. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.4 BACKFILL AND FILL

A. Place approved soil material in layers to required subgrade elevations, for each area classification listed below. Do not use water saturated soil material or contaminated material.

1. In excavations, use approved excavated or borrow material.

2. Under planted areas, use topsoil from site stockpile as specified in Section 31 10 00 Site Clearing.

3. Under walks and pavements, use subbase material, approved excavated or borrow material, or combination of both.

4. Under steps, use approved subbase material.

5. Under building slabs, use approved drainage fill material.

B. Backfill excavation as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.

2. Inspection, testing, approval, and recording locations of underground utilities.

3. Removal of concrete formwork, shoring and bracing: Prevent settling due to removal of materials from below structures.

4. Backfilling of voids with satisfactory materials.

5. Removal of trash and debris from excavation.

6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

C. Place backfill and fill materials in uniform lifts not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches loose depth for material compacted by hand-operated tampers. Prevent wedging action of backfill against structures and displacement of piping and conduit.

3.5 GRADING

A. Provide smooth finished surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated on Drawings, or between such points and existing grades.

B. Grade areas outside of building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, within the following tolerances above or below required finish grade.

1. Lawn and Unpaved Areas to Receive Topsoil: 0.10 foot

2. Pavements and Walks: Line, grade and cross-section, 0.10 foot

3. Structures: 0.10 foot.

C. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

D. Grade fill under building slabs smooth and even, free of voids, to required elevation. Provide final grades with a tolerance of plus or minus 1/4 inch in 10 feet.

E. All surface areas, except paved and sloped embankments exceeding 20:1, shall be hydroseeded in accordance with specifications in 01 57 23 Storm Water Pollution Prevention.

3.6 FIELD QUALITY CONTROL

A. See Section 01 45 00 Quality Control, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D6938.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), or AASHTO T 180.

D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no additional cost to the University.

3.7 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Transport approved clean excess excavated material to designated soil storage areas on University's property and within four miles of Project Site and stockpile soil. Keep enough soil to place 12 inches in planting areas, soil to be clean of debris including gravel.

B. Comply with the applicable provisions of Section 01 35 40 Environmental Mitigation

C. Remove excess excavated material, trash, debris and waste materials and dispose of it off the University's property.

D. Except for stripped topsoil or other material indicated to remain University property, cleared materials shall become the Contractor’s property and shall be removed from the Project site.

3.9 PROTECTION

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

C. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

D. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.10 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the applicable provisions of Section 01 74 19 Site Waste Management including, but not limited to:

1. Separate packaging materials by type and place in locations designated by the Contractor.

2. Place unused scrap material in locations designated by the Contractor.

END OF SECTION 31 22 00- EARTHWORK

SECTION 31 22 19 – FINISH GRADING

PART 1 – GENERAL

1.1 CONDITIONS

The general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this document.

1.2 SCOPE OF WORK

A. Provide all labor, materials, services and equipment indicated on Drawings and/or herein specified to complete all Landscape Grading Work.

B. Finish grading shall consist of scarifying and establishing finish grade to conform to the contours, grades, line and shapes as indicated on the Drawings, and insuring that all landscape areas are uniformly graded to an outlet.

C. Rough grading and land alteration of existing topographic conditions to conform to the contours, grades, lines and shapes indicated on the Civil Drawings and are not part of this scope of work.

1.3 DEFINITIONS

A. Subgrade: Surfaces upon which additional specified materials are to be placed, prepared or constructed.

B. Rough grade: The establishment of grades to one-tenth (1/10) foot plus or minus tolerance of grades required to accomplish the Work described in other documents and drawings.

C. Finish grade: The establishment of grades to a plus or minus tolerance of final grades as indicated on Drawings. Tolerances are specified in applicable documents of the specifications (i.e. Planting, Decorative Concrete, Decomposed Granite, etc.)

D. Grading intent: Spot elevations (grades) and contours are indicated based on the best available data. Design Professional's Drawings are referenced to provide additional site grading data. The intent is to maintain constant slopes between spot elevations. If a spot elevation is determined to be in error, or the difference in elevation between points change, contact the University's Representative immediately for field adjustments of spot elevations.

1.4 JOB CONDITIONS

A. Before submitting bid, visit the project site and examine the existing conditions under which the Work is to be performed. Note all conditions as to character and extent of Work involved. No request for additional payment due to failure to allow for working conditions shall be valid.

1.5 EXISTING UTILITIES

A. Contractor is responsible to contact C.G.A. at 811 and mark the location of all existing utilities before commencing Work.

B. Refer to the Design Professional Drawings for information on proposed site utilities and their locations.

C. Retain and protect in operating condition all active utilities traversing the site designated to remain.

D. Where existing utilities not indicated on the Drawings are encountered, support, shore up, protect same and immediately contact the University's Representative for continuance and/or relocation of such services.

1.6 PROTECTION OF EXISTING CONDITIONS and ADJACENT PROPERTIES

A. Use all means necessary to protect existing conditions designated to remain, newly constructed conditions and adjacent properties. Avoid any encroachment on adjacent properties.

B. Prevent damage to existing benchmarks, pavement and utility lines. In the event of damage or loss, immediately make all repairs and replacements required to the satisfaction of the University's representative and at no additional cost to the University.

1.7 EXISTING TREES

A. The Contractor shall protect the tops, trunks and roots of all existing trees on/or near the project site that are designated to remain.

B. Do not permit the parking of vehicles, or storage of materials or equipment under the dripline of existing trees.

C. Refer to Section 01 56 39 Tree Plant Protection for requirements when working around existing trees designated to remain.

1.8 QUALITY ASSURANCE

A. Finish grades shall conform to contours, grades, lines and shapes, as indicated on Drawings, with uniform slopes between finish grades or between finish grades and existing grades.

B. Establish finish landscape grades in a continuous, uniform line, resulting in a uniform surface with positive drainage and without ridges or water pockets.

C. Finish landscape grade tolerance shall be .04 feet plus or minus of final grades indicated on Drawings.

1.9 SUBMITTALS

A. If specified under this contract, provide one (1) cubic foot sample of topsoil material for the University's Representative's approval prior to delivery to the site, but in any case, prior to placement.

PART 2 – PRODUCTS

2.1 ON-SITE SOIL

A. Existing graded soil to within 1/10 foot (rough grade established by others) shall be free of rocks larger than one inch (1”) in diameter, roots, grasses, weeds and other foreign matter.

PART 3 – EXECUTION

3.1 GENERAL

A. Contractor to receive site as per the grades and spot elevations indicated on the Design Professional’s plans.

B. Rough grades shall be within plus or minus .10 foot of final finish grades as indicated on plans. If any discrepancies exist, notify the University's Representative immediately for direction.

C. Contractor shall be responsible for bringing rough grades into conformity with finish grades as indicated on the plans. Comply with tolerances specified in this document and as specified in applicable documents of the specifications (i.e. concrete, asphalt, Planting, etc.).

D. Conduct work in an orderly manner. Dirt shall not be permitted to accumulate on streets or sidewalks or washed into storm drains.

E. Use all means required to prevent the erosion of freshly graded areas during construction and until such time as proposed hard surfaces and landscaping have been constructed.

3.2 LAYOUT

A. Layout of all work under this Document shall be made by a licensed surveyor. Siegfried will be responsible for the licensed surveyor.

B. Maintain all bench marks, control monuments and stakes. Protect from damage and dislocation.

C. If any discrepancies are found by the surveyor between the Drawings and actual site conditions, the University's Representative reserves the right to make minor adjustment in Work Specified as necessary to accomplish the intent of the Contract Documents without increased cost to the University.

3.3 SUBGRADE PREPARATION

A. Cut out areas, to subgrade elevation, which are to receive paving and sidewalks.

B. Scarify subgrade to a depth of eight (8) inches and bring to a uniform moisture content.

C. Bring subgrade to required levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

D. Slope grade away from building minimum two-and-one-half (2-1/2) inches in ten (10) feet (2%) unless indicated otherwise on Drawings.

E. Compact subgrade to the following:
1. 6" depth at 95% relative compaction in accordance with ASTM D1557-78 for pavement areas.
2. 12" depth at 85% relative compaction in accordance with ASTM D1557-78 for landscape areas.

3.4 FINISH LANDSCAPE GRADING

A. Scarify or rototill to a 6” depth all planting areas prior to finish grade operations and work until uniform and free from large clods larger than one (1) inch in greatest dimension.

B. Finish grade shall conform, after compaction, to shapes, spot elevations and contours as indicated on Drawings, with uniform levels or slopes between finish elevations or between finish elevations and existing elevations.

C. Soil amendment and preparation shall comply with Section 32 93 00 Planting.

D. Spread excess soil material excavated from plant pits to establish subgrades in surrounding planting areas.

E. Top six (6) inches of all areas to be planted shall be free of stones, stumps or other deleterious matter one (1) inch in greatest dimension.

F. Compact soil in planting areas to 85% relative compaction in accordance with ASTM D1557-78.

G. Fine grade all planting areas to a smooth, loose and uniform surface. Eliminate uneven areas, ridges and depressions.

H. Shrub/ground cover planting areas shall be graded three and one-half (3-1/2) inches below adjacent paved areas, sidewalks, valve boxes, mow bands, drains, etc. in order to receive three (3) inch depth of mulch, establishing final grade one-half (1/2) inches below these surfaces.

I. Turf areas shall be graded ½” in hydroseed, 1/2” in sod, below adjacent paved area, sidewalks, valve boxes, mow bands, drains, top of seat walls etc. in order to receive turf, establishing final grade flush with these surfaces.

3.5 OBSERVATION SCHEDULE

A. Normal progress observations shall be requested by the Contractor from the University's Representative.

3.6 CLEAN UP

A. After all grading operations have been completed, remove all trash, excess soil, or rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site.

B. The contractor shall pick up all trash resulting from work no less than once a week, and/or the last working day of each week.

C. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition acceptable to the University and the University's Representative.

END OF SECTION 31 22 19- FINISH GRADING

SECTION 31 23 33- TRENCHING AND BACKFILLING

PART 1- GENERAL

1.1 SUMMARY

A. Section includes trenching, backfilling and compacting for utilities.

B. Related sections
1. Section 01 45 00 Quality Control.
2. Section 01 57 23 Storm Water Pollution Prevention.
3. Section 31 22 00 Earthwork.

1.2 REFERENCES

A. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3); 2000.

B. Manual of Warning Signs, Lights and Devices for Use in Performance of Work Upon Highways, issued by the California State Department of Transportation.

C. Office of Safety and Health Act (OSHA) Construction Safety Orders

D. California Code of Regulations Title 8: Construction Safety Orders.

1.3 DEFINITIONS

A. Finish Grade Elevations: Indicated on Drawings.

B. State Standard Specifications: State of California, Business and Transportation Agency, Department of Transportation (Caltrans), Standard Specifications, latest edition, excluding Sections pertaining to measurement and payment items.

C. Relative Compaction: Ratio, expressed as a percentage of field dry density as compacted to a maximum dry density of representative sample of the same material determined by American Society for Testing and Materials (ASTM) Test Method D1557 (c).

1.4 SUBMITTALS

A. Conform to the requirements of Section 01 33 23 Shop Drawings, Product Data and Samples for submittal procedures.

B. Product Data: Provide data for Products specified.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Project Record Documents: Record actual locations of pipe mains, valves, connections, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

E. Submit name of imported materials source.

F. Deliver samples of backfill and fill materials to University's Representative in quantities sufficient for testing. Deliver at least 15 days prior to use.

1.5 WARRANTY

A. The Contractor shall warrant against settlement for a period of one year after the date of final acceptance, and shall repair damage caused by settlement within that time. For the purpose of this Specification, settlement will be deemed to have occurred if on paved surfaces, the depression falls 3/8-inches below the average of the sides of the uncut portion.

PART 2- PRODUCTS

2.1 BEDDING AND BACKFILL MATERIALS

A. Bedding: bank sand; washed, free of silt, clay, loam, friable or soluble materials and organic matter; graded as follows: Sand bedding shall have a minimum sand equivalent of 45 and shall be uniformly graded from No. 4 to 200 mesh screen.

B. Backfill: Native backfill shall be selected material excavated from the trench. In all cases it shall be capable of compaction to at least the relative compaction required. In-place moisture content shall not be more than 5 percent over optimum when the material is silty or clayey and will not provide a stable subsurface.

2.2 SOURCE QUALITY CONTROL

A. See Section 01 45 00 Quality Control for general requirements for testing and analysis of soil material.

B. Provide materials of each type from same source throughout the Work.

PART 3- EXECUTION

3.1 PREPARATION

A. Preparation of Work

1. Underpin adjacent structures, which may be damaged by excavation Work, including utilities.

2. Maintain trench crossings for vehicular and pedestrian traffic at street crossing, driveways and fire hydrants.

3.2 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

C. See Section 31 22 00 Earthwork for additional requirements.

3.3 PIPE BEDDING

A. Bedding Excavation: Excavate trenches below grade of pipe bottom to the depth indicated on drawings.

B. Stabilization of Trench Bottom: When trench is unstable due to wet or spongy foundation, stabilize trench bottom with gravel or crushed rock. The University's Representative will determine suitability of trench bottom and amount of gravel or crushed rock needed to stabilize soft foundation. Remove and replace soft material with gravel or crushed rock when directed by University's Representative.

C. Placement of Bedding Material: Place sufficient bedding material in trench bottom up to grade of bottom of pipe. Relative compaction of tamped material shall be not less than 90 percent relative compaction. Place and compact additional bedding material to provide uniform bearing under the full length of the pipe to a minimum width of 60 percent of its external diameter.

3.4 TRENCHING

A. Work Included

1. Perform operations necessary to excavate earth, regardless of character and subsurface conditions, from the trench or adjacent thereto, and to place trench stabilization, pipe bedding, pipe cover, trench water removal, trench backfill and base, as shown on the Drawings, as well as providing traffic control and regulation through construction areas.

2. The Contractor shall do excavation of whatever substance is encountered to the lines and grades shown on the Drawings. Materials suitable for use as backfill shall be piled in an orderly manner a sufficient distance from the edge of the trench to avoid overloading and to prevent sliding into the trench.

3. The Contractor shall do such grading or Work as is necessary to prevent surface water from entering the excavation.

4. Demolish and remove existing pavement, curb and gutter, and other Project Site facilities as shown on the Drawings allow Project operations. Existing asphalt concrete pavement to be removed shall be saw cut in longitudinal neat straight lines while maintaining the cuts vertical for the full depth of the asphalt concrete pavement. Portions of existing concrete curbs, gutters and sidewalks to be removed

to permit new construction shall be cut using a concrete saw to provide neat straight lines with vertical cuts.

5. Maximum allowable open trench is 600 L.F. at any one time. Trenches outside the enclosure of the temporary construction fence are to be covered or otherwise protected at the end of each work day.

6. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

7. Do not interfere with 45 degree bearing splay of building foundations.

8. Cut trenches wide enough to allow inspection of installed utilities.

9. Hand trim excavations. Remove loose matter.

10. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.

11. Remove lumped subsoil, boulders and rock up to 1/3 cu. yd. in size.

12. Remove excavated material that is unsuitable for re-use from Project Site.

13. Stockpile excavated material to be re-used in area designated on Project Site in accordance with Section 31 22 00 Earthwork.

14. Remove excess excavated material from Project Site in accordance with provisions in Section 31 22 00 Earthwork.

B. Width of Trench: Except where otherwise specifically permitted by University's Representative, sides of trenches shall be vertical, shored, as required, and shall be of uniform width from top to bottom. Trenches shall be of a width as shown on the Drawings.

C. Trench Backfill: Native backfill shall be compacted by machine in uniform layers not exceeding 0.67 foot. Backfill shall be compacted to a relative compaction of not less than 90 percent to within 1 foot of subgrade. The upper 1 foot of subgrade shall be compacted to 95 percent; 85 percent compaction will be acceptable in undeveloped areas.

3.5 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

D. Buried pipe shall have at least 36 inches of cover and 12 inches of clearance from other utilities.

3.6 BACKFILLING

A. Backfill to contours and elevations indicated using unfrozen materials.

B. Fill up to subgrade elevations unless otherwise indicated.

C. Employ a placement method that does not disturb or damage other Work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

H. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise on the Drawings. Make gradual grade changes. Blend slope into level areas.

I. Reshape and re-compact fills subjected to vehicular traffic.

3.7 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 0.10 foot from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.10 foot from required elevations.

3.8 FIELD QUALITY CONTROL

A. See Section 01 45 00 Quality Control for general requirements for field inspection and testing.

B. The University will make soils tests when advised by the Contractor that in the Contractor’s opinion sufficient densities have been achieved. If the first tests in any areas fails, the Contractor shall pay for further testing in that area until specified densities are obtained. The University's Representative shall determine the number and location of tests required. Contractor shall provide a backhoe and operator upon request at no additional cost to the University.

C. Lights, flags, and other warning and safety devices for street and highway work shall conform to the requirements set forth in the current Manual of Warning Signs, Lights and Devices for Use in Performance of Work Upon Highways, issued by the California State Department of Transportation.

D. Preparation, excavation and trenching shall comply with California Code of Regulations Title 8: Construction Safety Orders.

3.9 CLEANING

A. Leave unused materials in a neat, compact stockpile during progress of work.

B. Remove unused stockpiled materials. Leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

3.10 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. The Contractor shall remove and dispose of all excess excavated material to a suitable site. The proper and legal disposal shall be the responsibility of the Contractor.

3.11 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the applicable provisions of Section 01 74 19 Site Waste Management including, but not limited to:
   1. Separate packaging materials by type and place in locations designated by the Contractor.
   2. Place unused scrap material in locations designated by the Contractor.

END OF SECTION 31 23 33- Trenching and Backfilling

SECTION 32 12 13- FLEXIBLE PAVEMENT

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphaltic concrete paving, wearing, binder and base course.
2. Surface sealer.
3. Paving fabrics.
4. Aggregate subbase course.

B. Related Sections:

1. Section 31 22 00- Earthwork.
2. Section 31 23 33- Trenching and Backfilling.
3. Section 32 17 23- Pavement Marking.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Asphalt Pavement Mix (Base Course):

1. Basis of Measurement: By cubic yard.
2. Basis of Payment: Includes preparing base, primer, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

B. Asphalt Pavement Mix (Wearing Course):

1. Basis of Measurement: By cubic yard.
2. Basis of Payment: Includes primer, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

1.3 REFERENCES

A. Asphalt Institute:

1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.

B. ASTM International:

1. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.

2. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

1.4 PERFORMANCE REQUIREMENTS

A. Paving: Designed for main street arteries.

1.5 SUBMITTALS

A. All submittals shall be in accordance with 01 33 23.

B. Product Data: Submit product information and mix design.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with California Department of Transportation Public Work's standards.

B. Mixing Plant: Conform to California Department of Transportation Public Work's standards.

C. Obtain materials from same source throughout.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2- PRODUCTS

2.1 MATERIALS

A. Asphalt Cement: ½" Maximum Medium Type "B" in accordance with California Department of Transportation Public Work's standards.

B. Asphalt Binder: PG 64-10 in accordance with California Department of Transportation Public Work's standards.

C. Aggregate for Base Course Mix: Class II ¾" In accordance with California Department of Transportation Public Work's standards.

D. Aggregate for Wearing Course Mix: In accordance with California Department of Transportation Public Work's standards.

E. Tack Coat: In accordance with California Department of Transportation Public Work's standards.

2.2 ASPHALT PAVING MIX

A. Use dry material to avoid foaming. Mix uniformly.

B. Base Course: In accordance with California Department of Transportation Public Work's standards.

C. Wearing Course: In accordance with California Department of Transportation Public Work's standards.

2.3 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00- Quality Control: Testing, inspection and analysis requirements.

B. Submit proposed mix design of each class of mix for review prior to beginning of Work.

PART 3- EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade subbase is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

C. Verify gutter drainage grilles and frames, manhole frames, and are installed in correct position and elevation.

3.2 SUBBASE

A. Prepare subbase in accordance with California Department of Transportation Public Work's standards.

3.3 PREPARATION – PRIMER

A. Apply primer in accordance with California Department of Transportation Public Work's standards.

3.4 PREPARATION - TACK COAT

A. Apply tack coat in accordance with California Department of Transportation Public Work's standards.

3.5 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Install Work in accordance with California Department of Transportation Public Work's standards.

B. Place asphalt within twenty-four (24) hours of applying primer or tack coat.

C. Place asphalt wearing course as indicated on the Plans.

D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.6 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Place wearing course within twenty-four (24) hours of placing and compacting binder course. When binder course is placed more than twenty-four (24) hours before placing wearing course, clean surface and apply tack coat before placing wearing course.

B. Compact each course by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

C. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.7 TOLERANCES

A. Section 01 45 00 - Quality Control

B. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

C. Scheduled Compacted Thickness: Within 1/4 inch.

D. Variation from Indicated Elevation: Within 1/4 inch.

3.8 FIELD QUALITY CONTROL

A. Section 01 45 00 - Quality Control: Field inspecting, testing, adjusting, and balancing.

3.9 PROTECTION OF FINISHED WORK

A. Immediately after placement, protect pavement from mechanical injury for forty-eight (48) hours or until surface temperature is less than 140 degrees F.

END OF SECTION 32 12 13- FLEXIBLE PAVEMENT

SECTION 32 15 00- GRAVEL SURFACING

PART 1- GENERAL

1.1 DESCRIPTION

A. This Section includes aggregate surfacing, complete, as shown, and as specified.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 REFERENCES

A. Standard Specifications - Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS.

B. ASTM - American Society for Testing and Materials.

1.3 DEFINITIONS

A. Percent Compaction: ASTM D1557, percentage of the maximum in-place dry density of the same material as determined by Soils Report.

1.4 SUBMITTALS

A. Product Data: Manufacturer's current catalog cuts and specifications for cellular confinement system and gravel base. Refer to Section 01 33 23 Shop Drawings, Product Data, and Samples for additional procedures.

1.5 QUALITY ASSURANCE

A. Testing Agency: Selected by University.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect gravel from contamination with foreign materials. Isolate stockpiles to prevent mixing of different material. Prevent contamination with organic materials.

1.7 PROJECT/SITE CONDITIONS

A. Environmental Requirements: Do not install crushed rock during rain or while subbase is wet from rain. Do not apply soil sterilant when winds exceed 10 mph or during or after rain.

B. Existing Conditions: For protection of existing plants to remain, see Section 01 56 39 Tree and Plant Protection

1.8 SEQUENCING AND SCHEDULING

A. Acceptance: Do not install work under this section prior to acceptance of subgrade preparation under another section.

B. Coordination: Coordinate with other trades to insure the following:

1. Irrigation Sleeving: To be placed prior to placement of aggregate base.

1.9 MAINTENENCE

A. Service: Immediately repair all damage to the work as the result of weather or traffic conditions. Report all damage resulting from work of other trades after acceptance of aggregate surfacing work. Repair to match adjacent undisturbed work.

PART 2 - PRODUCTS

2.1 3/4" Minus Crushed Rock

A. Crushed Rock Screenings:

1. Physical Properties:

a. 3/4" Minus Crushed Rock

Sieve Size	Percent Passing
3/4"	100
1/2"	95-100
3/8"	85-95
#4	25-65
#8	0-40
#16	0-20
#30	0-7
#50/60	0-5
#100	0-3
#200	0-2

2. Color: Grey

3. Sources: To be determined by contractor but approved by the University in accordance with Section 01 33 23 Shop Drawings, Product Data, and Samples

2.2 ACCESSORIES

A. Steel Header:

1. Size: 3/16 in. x 4 in. primed and painted steel.

2. Color: Black

3. Stakes: 15" Steel rebar as supplied by header manufacturer.

4. Product: Dura Edge by JD Russell Company, Joseph T. Ryerson & Son, Inc., Brighton By-Products Co., or equal.

B. Filter Fabric: Non-woven geotextile fabric.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Subgrades shall have been rough graded to within 0.10 ft. of finish grades less depth of gravel surfacing.

B. Verify that concrete bands [or adjacent paving] [and irrigation sleeving] have been installed and accepted under another Section prior to commencement of work.

3.2 PREPARATION

A. Compaction: After completion of soil sterilization, compact subgrade to minimum 95% compaction.

B. Steel Header:

1. Headers: Install header true to line and grade as shown on the Drawings. Align header edges and set flush with adjacent paving. Field weld all butt joints.

2. Stakes: Stakes shall be a minimum of 14 inches long, and longer as required for solid anchorage. Header to be Field welded to stakes - see drawings for spacing.

3.3 INSTALLATION

A. Gravel Surfacing:

1. Lines and Levels: Install all gravel surfacing true to grade, properly coinciding with adjacent work and elevations. Provide a finished surface uniform in texture and appearance. Do not permit finished work to vary more than 1/8 in. in 10 ft. from true profile and cross section.

2. Damaged or Defective Installation: Repair and replace in accordance with these Specifications at no additional cost to University.

3.4 FIELD QUALITY CONTROL

A. Tests: For each lift, have the testing laboratory verify the degree of compaction. Recompact failed areas until specified compaction is achieved. Testing to be paid for by Contractor.

3.5 PROTECTION

A. Protect the paving against traffic, injuryor defacement, or damage by rain during curing period for cement-stabilized aggregate surfacing and subsequent construction operations until Final Acceptance.

END OF 32 15 00- GRAVEL SURFACING

SECTION 32 17 23- PAVEMENT MARKINGS AND SIGNS

PART 1- GENERAL

1.1 SUMMARY

A. Section includes pavement marking, striping and signs.

B. Related Sections:

1. Section 32 12 13- Flexible Pavement.

1.2 REFERENCES

A. Caltrans State Standard Specifications, 2010 Edition.

B. M.U.T.C.D California Supplement, Latest Edition. Figure 3A-1 Detail 8, Figure 3A-1 Detail 21, Figure 3B-16, and Figure 3B-20 for Striping.

C. M.U.T.C.D California Supplement, Latest Edition. R2-1 (20 MPH), R1-1, R3-5R, AND W41-3 “SLOW” for Signs.

D. CBC - California Building Code, 2013 Edition, Section 112

1.3 SUBMI1TALS

A. Section 01 33 23- Shop Data, Product Data and Samples

B. Product Data: Submit manufacturer’s printed product data on all coatings specified, including preparation and application instructions.

C. Samples:

1. Submit two paper chip samples, 3 inch by 5 in size illustrating range of colors and textures available for each surface finishing product scheduled.

2. Submit two painted samples, illustrating selected colors and textures for each color and system selected. Submit on white card stock, 8 inch by 10 inch in size.

D. Manufacturer’s Installation Instructions: Submit the manufacturer’s current recommended methods of installation, including relevant limitations, safety and environmental cautions, application rates, special surface preparation procedures, and substrate conditions requiring special attention.

E. Manufacturer’s Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALIFICATIONS

A. Manufacturer Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Applicator: Company regularly engaged and specializing in the application of pavement markings, with minimum three (3) years documented experience.

C. Regulatory Requirements: Comply with applicable codes and regulations of cognizant governmental agencies having jurisdiction, including those having jurisdiction over airborne emissions and industrial waste disposal. Where those requirements conflict with this Specification, comply with the more stringent provision.

D. Volatile Organic Compounds (VOC): Use only products in compliance with VOC content limits required by state and local regulations.

1.5 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer’s name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer’s instructions. Protect materials from adulteration by infiltration.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Perform the Work of this Section under environmental conditions no less stringent than those stipulated by the manufacturers of the materials used.

1. Take precautions necessary to avoid and mitigate the effects of wind drift in the application of liquid materials.

2. Do not apply marking paint when weather is foggy or rainy, or ambient temperatures are below 40 degrees F, nor when such conditions are anticipated during eight hours after application.

B. Volatile Organic Content (VOC). Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.

1.7 EXTRA MATERIALS

A. Supply one (1) gallon of each color, type, and surface texture of paint installed. Store where directed.

B. Label each container with color, type, texture, and room locations, in addition to manufacturer's label.

PART 2- PRODUCTS

2.1 PAINTED PAVEMENT MARKINGS

A. Manufacturers:

1. Dunn-Edwards. Type: W801 Traffic Marking Paint or equal

2. Frazee Industries, Inc. Type: 506 Traffic Line Paint or equal

3. ICI Dulux. Type: 4800 Series Traffic Paint or equal

B. Product Description: Dunn Edwards Vin-L-Stripe Traffic Marking Paint, W80l Series, epoxy modified acrylic latex based, specifically formulated for application to asphalt and concrete vehicular traffic surfaces. Provide paint certifiable by the manufacturer as being in accordance with the California Air Resources Board (CARB) rules in effect at the time of application.

1. Factory mixed, quick drying and non-bleeding.

2. Color

a.	Text	White and Blue as shown on drawings.
b.	Parking divider stripes:	White.
c.	No parking zone markings:	Yellow.
d.	No parking curb:	Red.
e.	Accessible Zone markings:	White and Blue as shown on drawings.
f.	Crosswalk striping:	White.
g.	Directional arrows:	White.
h.	Driving lane dividers:	White.

3. Blue paint for the symbol of accessibility: International Symbol of Accessibility shall comply per CBC 11B-703.2.1 The symbol shall consist of a white figure on a blue background The blue shall be color No. FS 15090 in Federal Standard 595B.

2.1 EQUIPMENT

A. Pressurized, self-contained paint machine capable of applying a straight line from 2 inches to 6 inches wide, with consistent coverage of a minimum of 150 square feet per gallon.

B. Machine Calibration:

1. Paint Line Measuring Device: Calibrate automatic line length gauges to maintain tolerance of plus or minus 25 feet per mile.

2. Paint Guns: Calibrate to simultaneously apply paint binder at uniform rates as specified with an allowable tolerance of plus or minus 1 mil.

C. Other Equipment

1. For application of crosswalks, intersections stop lines, legends and other miscellaneous items by walk behind stripers, hand spray or stencil trucks, apply with equipment meeting requirements of this section. Do not use hand brushes or rollers.

PART 3- EXECUTION

3.1 EXAMINATION

A. Verify surfaces are ready to receive Work as instructed by product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

3.2 PREPARATION

A. Maintenance and Protection of Traffic:

1. Provide short term traffic control and barriers in accordance with Section 01 56 00.

2. Prevent interference with marking operations and to prevent traffic on newly applied markings before markings dry.

3. Maintain travel lanes between 7: 00 AM to 9: 00 AM, and between 4: 00 PM and 6: 00 PM.

4. Maintain access to existing buildings and other properties requiring access.

B. Locate markings as shown on Drawings. Provide qualified technicians to supervise equipment and application of markings. Lay out markings using guidelines, templates and forms. Obtain verification from Design Professional for confirmation of lay out; colors, and placement of markings.

C. Correct defects and clean surfaces affecting work of this section. Sand all gloss finishes to sheen. Remove existing coatings that are flaking or otherwise in unacceptable condition to receive paint Preparation or removal of coatings containing lead must be performed in accordance with all EPA and OSHA guidelines.

D. Concrete and Masonry Surfaces: Pressure wash to remove all dirt, loose mortar, scale, salts, alkalies, and other detrimental substances. Remove oils and grease with solution of trisodium phosphate; rinse well and allow to dry. Remove all plant growth, including all growth spores and spore residue where designated.

E. Asphalt Concrete: All surfaces must be cleaned free from grease, oil, dirt, mildew, stains and other contaminants that would cause adhesion problems. Remove loose, peeling or

chalky paint by high-pressure washing or other appropriate methods. Surfaces must be completely dry before application.

1. Allow asphalt concrete to age for 30 days before starting pavement marking.

3.3 EXISTING WORK

A. Remove existing markings in an acceptable manner. Do not remove existing pavement markings by painting over with blank paint Remove by methods that will cause least damage to pavement structure or pavement surface. Satisfactorily repair any pavement or surface damage caused by removal methods.

B. Clean and repair existing remaining or reinstalled lines and legends.

3.4 APPLICATION

A. Agitate paint for 1-15 minutes prior to application to ensure even distribution of paint pigment.

B. Apply marking paint at rate of one gallon per 150 square feet (equivalent to approximately one gallon for 450 lineal feet of 4 inch wide stripe). Rate can increase to a maximum of 400 square feet per gallon based on conditions of surface to be coated.

C. Apply paint with mechanical equipment:
1. Provide uniform straight edges without overspray.
2. Uniform line width of 4 inches, unless otherwise noted on Drawings.
3. Provide hatching in accessible parking areas as required by Code.
4. Use single line striping between parking stalls.
5. Apply at manufacturer’s recommended rates to provide a minimum wet film thickness of 13 mils.
6. Identify parking spaces with text where shown on drawings.

D. Accessibility Symbol: Apply international accessibility symbol on pavement surface in accordance with CCR Title 24 Section 1129B. The surface of each accessible parking space or stall shall have a surface identification duplicating the following scheme:
1. By outlining a profile view of a wheelchair with occupant in white on blue background. Locate profile view so that it is visible to a traffic enforcement office when vehicle is properly parked in the space. Size: 36 inches high by 36 inches wide.

E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

F. Prior to applying, mix paint a sufficient length of time to thoroughly mix the pigment and vehicle together, and keep thoroughly agitated during its application.

G. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

H. Apply markings to indicated dimensions at indicated locations.

I. Prevent splattering and over spray when applying markings.

J. Unless material is track free at end of paint application convoy, use traffic cones to protect markings from traffic until track free. When vehicle crosses a marking and tracks it or when splattering or over spray occurs, eradicate affected marking and resultant tracking and apply new markings.

K. Collect and legally dispose of residues from painting operations.

3.5 PROTECTION OF FINISHED WORK

A. Do not permit traffic over the painted striping and pavement markers until the paint has cured.

3.6 APPLICATION TOLERANCES

A. Maximum Variation from Wet Film Thickness: 1 mil.

B. Maximum Variation from Wet Paint Line Width: Plus or minus 1/8 inch.

C. Maximum Variation from Specified Application Temperature: Plus or minus 5 degrees F.

3.7 PROTECTION OF FINISHED WORK

A. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free. Follow manufacturer’s recommendations or use minimum of 30 minutes. Consider barrier cones as satisfactory protection for materials requiring more than 2 minutes dry lime.

3.8 SCHEDULE OF COLORS

A. Stripes between standard parking stalls: White.

B. Stripes between accessible parking stalls: White.

C. No parking zones diagonal striping: White.

D. Accessible pedestrian crosswalks: White.

E. Accessible Parking Curb: Blue.

F. Direction Arrows: White.

G. NO PARKING stenciled letters: White as shown on drawings.

END OF SECTION 32 17 23- Pavement Markings and Signs

SECTION 33 10 00- WATER DISTRIBUTION

PART 1- GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings for site domestic, utility water (irrigation service), and chilled water supply and return.

B. Valves and appurtenances.

C. Water Sampling Station.

1.2 RELATED SECTIONS

A. Section 01 57 23 Storm Water Pollution Prevention.

B. Section 31 23 33 Trenching and Backfilling: Excavating, bedding, and backfilling.

1.3 REFERENCES

A. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS; American Water Works Association; 2001 (ANSI/AWWA C508).

B. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; 2001 (ANSI/AWWA C509).

C. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution; American Water Works Association; 1997 (ANSI/AWWA C900/C900a).

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001(R 2002) (ANSI B16.18).

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001.

F. ASTM B 88 - Standard Specification for Seamless Copper Water Tube; 2003.

G. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2004 and errata.

1.4 SUBMITTALS

A. See Section 01 33 23 Shop Drawings, Product Data and Samples for submittal procedures.

B. Product Data: Provide data acknowledging that products meet requirements of standards referenced.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Restraint Calculation: Provide calculations for mechanical restraint distances for all pipe joints. Provide data acknowledging that calculations provided conform to manufacturer's recommendations for size of pipe, type of pipe, and site soil type.

F. Project Record Documents:

1. Record location of pipe runs, connections, valves, restraints and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2- PRODUCTS

2.1 PIPE MATERIALS

A. Plastic - 4 inches and over: PVC pipe shall be minimum Class 200 AWWA C900 (minimum Class 165 AWWA C905 for pipes 16 inches and larger). Underwriters' Laboratories, Inc. (UL) listed, Factory Mutual and National Sanitation Foundation (NSF) approved. Pipe shall be furnished in minimum standard lengths of 20 feet

1. Fittings: Wrap and seal coated AWWA C111 cast iron mechanical joint, 250 pound working pressure, ductile iron, mechanical joints with SBR rubber ring gaskets. Flanged outlets shall conform to ANDI B16.1, 125 pounds.

2. Bolts and nuts for flanges shall be Type 316 stainless steel, American Society for Testing and Materials (ASTM) A193, Grade B8M hex head bolts and American Society for Testing and Materials A194, Grade 8M, hex head nuts. Washers shall be of the same material as the bolts.

2.2 VALVES

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Valves less than 2 Inches:

1. Bronze Gate Valve: Stockham Model B103/B104, Nibco Model T-113/S-113, or equal with non rising stem, class 125 minimum.

C. Valves 2 inches through 12 inches:

1. Gate valve: American Flow Control Series 2500, Mueller 2360 Series, or equal. Valve shall be resilient seat, with non-rising stem opening counter-clockwise with O-ring stem seal and suitable ends for connection to the type of pipe or fitting used. The working pressure rating of gate valve shall be a minimum of 250 p.s.i.g. Buried valves shall have a 2 inch square operating nut. The interior and exterior of the body and bonnet shall be coated with fusion bonded epoxy. The body to bonnet bolts and nuts shall be stainless steel.

2.3 HYDRANTS

A. Hydrant shall be AVK Model #2490 Standard Style Wet barrel, with two 2-1/2 inch outlets and one 4-1/2 inch outlet. All outlets shall have National Standard fire hose thread.

2.4 WATER SAMPLING STATION

A. Water Sampling Station shall be Placer Waterworks Water Sampling Station.

2.5 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 23 33 Trenching and Backfilling.

B. Cover: As specified in Section 31 23 33 Trenching and Backfilling.

2.6 COUPLINGS AND SLEEVES

A. General: All couplings and sleeves shall be a minimum of 250 psi working pressure-rated unless otherwise noted.

B. For DIP and PVC pipe:

1. Unless otherwise noted, couplings and sleeves for DIP and PVC shall be ductile iron conforming to AWWA C153, size 3 through 24 inch and AWWA C110 greater than 24 inch, and shall be 350 psi working pressure rated. AWWA C100 fittings shall be ductile iron only. Couplings, sleeves, and accessories shall be manufactured by U.S. Pipe TrimTyte, Union Foundry, Tyler; or equal.

2. Wrap and seal DIP.

3. Unless otherwise noted, flanges on all DIP spools shall conform to AWWA C115.

4. Push-on joints shall have SBR rubber ring gaskets.

5. All fittings shall be restrained joints. Pipes shall be restrained using a wedge-action, self-actuating lug type restraint devise as manufactured by EBAA Iron Sales, StarGrip, or equal. Concrete thrust blocks are not permitted except at connections to existing unrestrained pipe or fittings or at fire hydrants.

6. All pipe joints within the minimum distances listed in the following table shall be restrained. Restraint shall be by use of locking gasket for ductile iron pipe. Restraint for PVC pipe shall by use of a restraint harness EBAA Series 2800, StarGrip, or equal.

	Minimum Restraint Length, feet						
	Horizontal Elbows				Tee, Run & Branch	One-Size Reducer	Dead End
Pipe Diameter, inches	11.25	22.5	45	90			
3	1	2	3	8	8		24
4	1	2	4	10	10	9	29

6	1	3	6	14	14	21	42
8	2	4	7	18	18	23	55
10	2	4	9	21	21	22	66
12	2	3	7	17	17	26	53
14	2	4	8	20	20	16	61
16	2	4	9	22	22	16	69
18	2	5	10	25	25	16	77
20	3	5	11	27	27	16	84
24	3	6	13	32	32	30	100
30	4	8	16	38	38	42	121
36	4	9	18	45	45	43	143

2.7 ACCESSORIES

A. Mechanical Restraints:

1. PVC Pipes: Certain Teed Certa Lock, Romac Grip Rings, or equal.

B. Valve Boxes: Precast concrete with cast iron traffic covers with the word WATER embossed on the top surface of the lid. Christy G5 or equal. Cover shall be painted light blue (ICI Devoe DC41000 semi gloss or equal) for domestic water valves and white (ICI Devoe, DevFlex-659 White Semi Gloss 4206, or equal) for Utility water valves. For chilled water valves, the letters “CHW” shall be welded or embossed on the top surface of the lid and the cover shall be painted green. For all valves an identification number shall be welded onto valve box rim. Identification number shall be assigned by Operations and Maintenance, Engineering Services.

C. Miscellaneous nuts and bolts shall be 316 stainless steel.

D. Rods and Clamps: Socket clamps shall be stainless steel, four bolt type, equipped with stainless steel socket clamp washers and nuts Grinnell Fig. 595 and 594, Elcen Fig. 37 and 37X, or equal.

1. Rods shall be stainless steel, 3/4 inch diameter.

E. All underground water piping shall be accompanied by a Solid Core #10 copper tracer wire. Both ends of tracer wire shall be accessible at all utility valve boxes.

F. Line Marker: Underground-type conductive line marker, permanent, brightly colored, continuous-printed plastic tape, intended for direct burial service; not less than 6 inches wide by 4 mils thick. Provide blue tape with "CAUTION WATER LINE BURIED BELOW" in black letters; Allen Systems Inc., Emed Co. Inc., or equal.

G. Tapping Sleeve: Cast iron or stainless mechanical joint type sleeve, sized specifically for actual O.D. and piping material, Mueller, Clow, or equal.

PART 3- EXECUTION

3.1 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.2 TRENCHING

A. See Section 31 23 33 Trenching and Backfilling for additional requirements.

B. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Buried pipe shall have at least 36 inches of cover for pipes up to 8 inches, 40 inches of cover for 10 inch pipes, 44 inches of cover for 12 inch pipes and 48 inches of cover for 16” pipes and larger and 12 inches of clearance from other utilities.

D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, and then complete backfilling.

3.3 INSTALLATION - PIPE

A. Have on hand all installation manuals, brochures, and procedures for the equipment and materials concerned.

B. Follow manufacturer instructions, where such are provided, in all cases that cover points not shown on the Drawings or specified herein. Manufacturer's instructions do not take precedence over the Drawings and Specifications. Where manufacturer's instructions are in conflict with the Drawings and Specification, submit the conflicting instructions to the University's Representative for clarification before performing the work.

C. Use fittings to make all changes in direction and size unless otherwise indicated on the Drawings.

D. Maintain factory plastic end covers on the pipe during storage. Caps shall be removed upon installation of pipe to insure cleanliness.

E. Lay piping on a bed of the specified sand, at least 6-inches thick, on firm undisturbed earth. Remove loose rock, clods, and debris from the trench before placing bedding sand and before laying any pipe.

F. The piping shall be made up with the pipe barrel bearing evenly along its full length on the sand bed on the bottom of the trench.

G. In the case of steel or other rigid joint piping, excavate holes under joints and connections for access for making up, welding, testing and wrapping joints.

H. Thoroughly clean out each section of pipe and fitting before lowering into the trench. Clean each pipe or fitting by swabbing-out, brushing-out, blowing-out with compressed air, washing-out with water, or by any combination of these methods necessary to remove all foreign matter.

I. If cleaned pipe sections and fittings cannot be placed in the trench without getting dirt into the open ends, tie tightly woven canvas or other type of approved cover over the ends of the pipes and fittings until they have been lowered into position in the trench. After removal of the covers in the trench, completely remove foreign matter from the pipe ends and fittings.

J. Do not lower any pipe or fitting into a trench that contains water. Pump water from wet trenches, and keep the trenches dry until the joints have been completed and the open ends of the pipes have been closed with watertight plugs or bulkheads. Do not remove the plug or bulkhead unless the trench is dry.

K. Assemble lengths of PVC that are joined by couplings, Tyton type push-on joints, Ring-Tite, Fluid-Tite, or equal, such that centerline of two pipes being joined do not form an angle exceeding 2 inches in any plane. In addition, the angle formed in the vertical plane shall not exceed 1-1/2 inch.

L. Transition plastic pipe to ductile iron when within 10 feet of a steam line. Provide 6 inches minimum powdered insulation around ductile iron sewer pipe when within 5 feet of steam line. Install insulation according to manufacturer's recommendations.

M. Install trace wire on top of pipe.

N. Install continuous line marker 18 inches above top of pipe; coordinate with Section 31 23 33 Trenching and Backfilling.

3.4 INSTALLATION - VALVES AND HYDRANTS

A. Set valves on solid bearing.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.

D. Hydrant shall be installed with the outlets facing the street, with 4-1/2 inch opening no less than 2 feet or more than 7 feet from the street curb or edge of pavement.

E. The center of the lowest outlet shall be no less than 18 inches above finished grade.

F. Hydrants to be painted by University in accordance with National Fire Protection Association (NFPA) NFPA 24, edition 2002 requirements.

G. Where subject to mechanical injury, hydrants to be protected in accordance with the requirements of the applicable editions of National Fire Protection Association (NFPA) 13, 14, and 24, and the appropriate editions of the California Building code and the California Fire Code, so as not to interfere with connection to the outlets.

3.5 CONNECTIONS TO EXISTING WATER SYSTEM

A. Under no circumstances shall existing lines or utilities be interrupted without prior approval of the University. Submit a request for this approval to the University's Representative, and also state the maximum duration of shutdown. Operation of the central plant governs. The Contractor's schedule may have to be adjusted or work performed during off-hours.

B. Schedule all outages for utility tie-in work well in advance, and by written notice to the University at least 7 working days in advance of the desired shutdown.

C. In preparation for tie-ins to the utility systems, the Contractor shall coordinate with the University's Representative before draining and/or blowing the existing piping prior to start of tie-in work by the Contractor. In all cases, the University will close the appropriate valves to isolate the area of work.

3.6 FLUSHING

A. The entire piping system shall be thoroughly flushed out until acceptance of the University's Representative. All tests shall be conducted at such times as directed by and in the presence of the University's Representative.

3.7 PIPE TESTING

A. Water piping shall be hydrostatically tested at 200 psi pressure for four hours and proven watertight. Provide all instruments, facilities, and labor to conduct testing and placing in operation.

B. Piping shall be tested in sections. Testing under this Section of the work shall be done before final connections to existing utility piping is made, with the provision that subsequent leaks, if developed, at these conditions shall be corrected.

C. Any part of the system, including all accessories, that shows failure during testing shall immediately be repaired or replaced with new materials. The system shall be completely retested after repair for replacement. This procedure shall be repeated, if necessary, until all parts of the system withstand the specified tests. All retesting costs shall be part of the Contract.

D. Tests shall be witnessed by the University's Representative. At least 48 hours notice of tests shall be give.

3.8 DISINFECTION

A. All domestic water piping shall be disinfected upon installation according to UCM Department of Environmental Health & Safety Standards and latest addition of AWWA C-651.

B. Disinfect fire hydrant lateral and line from point of connection to FH.

3.9 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 45 00 Quality Control.

3.10 Construction Waste Management

A. Comply with the applicable provisions of Section 01 74 19 Cleaning and Construction Waste Management including, but not limited to:

1. Separate packaging materials by type and place in locations designated by the Contractor.

2. Place unused scrap material in locations designated by the Contractor.

END OF 33 10 00- WATER DISTRIBUTION

SECTION 33 40 00- STORM DRAINAGE

PART 1- GENERAL

1.1 SECTION INCLUDES

A. Storm drainage piping, fittings, and accessories (gravity systems only).

B. Connection of drainage system to existing drainage system.

C. Inlets and Cleanouts, including covers.

1.2 RELATED SECTIONS

A. Section 01 33 23 Shop Drawings, Product Data and Samples.

B. Section 31 23 33 Trenching and Backfilling: Excavating, bedding, and backfilling.

C. Section 01 57 23 Storm Water Pollution Prevention.

1.3 REFERENCES

A. ASTM D 3034 - Standard Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings; 2004a.

B. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2005.

C. American Water Works Association (AWWA) C111/A21.11 – American National Standard for Rubber Gasket Joints For Cast Iron and Ductile Iron Pressure Pipe and Fittings; 2000.

D. ASTM A48/A - Standard Specification for Gray Iron Castings; 2003.

1.4 DEFINITIONS

A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.5 SUBMITTALS

A. See Section 01 33 23 Shop Drawings, Product Data and Samples for submittal procedures.

B. Product Data: Provide data acknowledging that products meet requirements of standards referenced.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Project Record Documents:

1. Record location of pipe runs, connections, inlets, cleanouts, manholes and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2- PRODUCTS

2.1 DRAINAGE PIPE MATERIALS

A. Plastic Pipe: ASTM D 3034, Type PSM, SDR 35, Poly Vinyl Chloride (PVC) material; inside nominal diameter as indicated on Drawings.

B. Plastic Pipe Joint Seals: ASTM D 3212 PVC elastomeric joints using elastomeric seals complying with ASTM F 477.

C. Corrugated High Density Polyethylene Pipe (CPEP): Pipe shall have a smooth interior and annular exterior corrugations. Pipe and fitting material shall be high density polyethylene meeting ASTM D3350 minimum cell classification 324420C for 4-10 inches diameters or 335420C for 12-60 inches diameters. Pipes 4-10 inches in diameter shall meet American Association of State Transportation Officials (AASHTO) M252, Type S, and 12-48 inches diameter shall meet AASHTO M294, Type S. Pipe material shall be a slow crack resistance material evaluated using the single point notched constant tensile load (SP-NCTL) test. Average SP-NCTL test specimens must exceed 24 hours with no test result less than 17 hours.

D. Corrugated High Density Polyethylene Pipe (CPEP) Joint Device: Bell-and-spigot meeting AASHTO M252, AASHTO M294 or MP7. Joints shall be silt-tight and non-rated watertight. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477 with the addition that the gaskets shall not have any visible cracking when tested according to ASTM D1149 after 72-hour exposure in 50 PPHM ozone at 104 degrees F.

E. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.2 PIPE ACCESSORIES

A. Line Marker: Provide warning detectable tape; permanent, bright-colored, continuous-printed plastic tape, intended for direct burial service; not less than 6 inches wide by 4 mils thick. Provide green tape with "CAUTION STORM LINE BURIED BELOW" in black letters.

2.3 CLEANOUTS AND CATCH BASINS

A. Cleanouts and Catch Basins: As indicated on Drawings.

B. Provide Lid and Frame as indicated on Drawings.

C. Lid and Frame: ASTM A48/A, Class 35B, H-20 Traffic Rated, minimum weight 130 pounds (cover) 135 pounds (frame), D&L Supply A-1024, South Bay Foundry SBF 1900 CPH, or equal

2.4 BEDDING AND COVER MATERIALS

A. Pipe Bedding Material: As specified in Section 31 23 33 Trenching and Backfilling.

B. Pipe Cover Material: As specified in Section 31 23 33 Trenching and Backfilling.

PART 3- EXECUTION

3.1 TRENCHING

A. See Section 31 23 33 Trenching and Backfilling for additional requirements.

B. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.2 INSTALLATION - PIPE

A. Lay piping beginning at low point of system, true to grades and alignment indicated on Drawings, with unbroken continuity of invert.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.

1. Plastic Pipe: Also comply with ASTM D 2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Install continuous line marker 18 inches above top of pipe; coordinate with Section 31 23 33 Trenching and Backfilling.

3.3 INSTALLATION - CATCH BASINS

A. Provide as recommended by manufacturer.

B. Set cover frames and covers level without tipping, to correct elevations.

3.4 PIPE PENETRATIONS

A. For pipe penetrations through existing manholes, core through, provide gasket around pipe, grout penetration on both sides and provide a minimum of 6 inches around collar outside of the manhole or inlet structure penetration.

3.5 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so that finished Work will conform as nearly as practicable to requirements specified for new Work.

B. Into underground structures or pipes 24 inches and larger: Cut opening into unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape of and be flush with inside wall. On outside of pipe 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. Provide 3000 pounds per square inch concrete. Use epoxy bonding compound as interface between new and existing concrete and piping materials.

C. Take care while making tap connections to prevent concrete or debris from entering existing pipe or structure. Remove debris, concrete, or other extraneous material, which may accumulate.

3.6 CLEANING

A. Piping greater than 6 inches: clean pipe to be tested by propelling a snug fitting inflated rubber ball through the pipe with water to remove any debris.

B. Piping 6 inches and smaller: flush piping applying full size pipe flushing.

3.7 LEAK TESTING

A. For either exfiltration or infiltration test, the maximum leakage shall not exceed 250 gallons per inch of pipe diameter per mile per 24 hours as measured over a period of 30 minutes minimum. Should the leakage exceed the maximum allowable rate, the contractor shall repair, overhaul, or rebuild the defective portion of the sewer line. After repairs have been completed by the Contractor, the line shall be retested as specified above.

B. Manholes shall be filled with water to the rim of the frame casting and shall lose no more than 2 inches over a period of 30 minutes.

C. The final test shall be performed after the line has been laid and all backfill placed and compacted. The Contractor, at his option, may test the line at any time during construction. However, the final test for acceptance shall be made only after all backfill is in place and compacted. In the event that the exfiltration test prescribed above is impractical due to wet trench conditions, these portions of the sewer line where such conditions are encountered will be tested for infiltration. The University’s Representative shall determine whether the exfiltration or infiltration test will be used.

D. Even though the test for leakage is within the prescribed limits, the Contractor shall repair any obvious leaks.

E. Low pressure air testing may be used in lieu of water testing at the option of the Contractor. Water testing may be required by the University’s Representative. The following procedure shall be used for air testing:

1. Plug all pipe outlets with suitable test plugs. Brace each plug securely.

2. If the pipe to be tested is submerged in ground water, insert a pipe probe, by boring or jetting, into the backfill material adjacent to the center of the pipe, and determine the pressure in the probe when air passes slowly through it. This is the back pressure due to ground water submergence over the end of the probe. All gauge pressures in the test should be increased by this amount.

3. Add air slowly to the portion of the pipe installation under test until the internal pressure is raised to 5.0 psig.

4. Check exposed pipe and plugs for abnormal leakage by coating with a soap solution. If any leakage is observed, bleed off air and make necessary repairs.

5. After an internal pressure of 5.0 psig. is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.

6. After the two minute period, disconnect the air supply and start stopwatch. The pressure of 5.0 psig. shall be maintained for 5 minutes.

7. As an alternate, the contractor may request the air testing procedure as presented in Section 306-1.4.4 of the 1997 edition of the “Greenbook” Standard Specifications.

3.8 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the applicable provisions of Section 01 74 19 Site Waste Management including, but not limited to:

1. Separate packaging materials by type and place in locations designated by the Contractor.

2. Place unused scrap material in locations designated by the Contractor.

END OF 33 40 00- STORM DRAINAGE