LONG BEACH CITY COLLEGE DISTRICT
CONTRACTS MANAGEMENT DEPARTMENT
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BID C1994B BUILDLING B POWER AND DATA UPGRADE PROJECT AT THE LIBERAL ARTS CAMPUS ADDENDUM NO. 1

May 17, 2019

This Addendum forms a part of the Contract Documents and modifies the original DSA approved bid documents. Acknowledge receipt of the Addendum on Section 1.2 of the Bid Proposal. Failure to do so may result in the bid being deemed non-responsive.

Note: It is the responsibility of all bidders to notify all subcontractors from whom they request bids and from whom they accept bids of all changes contained in this addendum.

ADDENDUM NO. 1 CONTENTS

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I. CHANGES TO NOTICE CALLING FOR BIDS

1. Latest Time/Date for Submission of Bid Proposals is hereby changes from May 23, 2019 at 2:00 P.M. to May 28, 2019 at 2:00 P.M.

II. ANSWERS TO PRE-BID INQUIRIES

1. Q: Can you please provide the following data cabling information: brand, parts, installation guidelines, rack elevation, cable management instructions, testing?

A: *Division 27 Communication specification sections are provided as attachments to this Addendum No. 1. See list of specification changes below. The Campus Standard for data cabling (copper) is TrueNet, also known as Commscope. The Campus Standard for fiber optic cables is Corning LANscape. Contractor to verify that the communication sub-contractor are certified to install and terminate both cables as it pertains to the scope of work. Certifications are to be provided as part of the Communication submittal package to ensure that installers are Southern California certified installers of Corning LANscape and TrueNet/ Commscope cables.*

3. Q: Key note 11 on plan page E301, 302 and 303 reads "PROVIDE AV SYSTEM DEVICE, SPEAKERS AND CABLES." Can you please provide a spec for the AV devices, speakers and cables that we are to provide?

A: *AV devices, speakers and cables will be Owner Furnish Owner Installed. Contractor as part of this scope of work is to provide conduit, wiremold, back box, etc. for the future AV device locations and connections.*

4. **Q**: At the Pre-Bid Conference and Site Walk, there was mention of night time work and noise permit, what are the hours and who is responsible for the permit?

   A: *Per Article 17.6 the hours of work at the site are from 10pm – 6am, Monday thru Friday. Article 17.37 Contractor Obtained Permits notes the permit requirements and Contractor shall be responsible for obtaining the permit.*

5. **Q**: There are some cabinets to be removed on the 3rd floor. The Hazmat report provided does not have any requirements or survey for these rooms. Please provide information on how to proceed.

   A: *Floor tiles and countertops in this building, including the 3rd floor, contain asbestos similar to those listed on the 1st and 2nd floor of the Hazmat report. Abate and remove all floor tiles below the entire footprint of the cabinet and replace with new. Abate countertops and remove. Contractor shall be responsible for understanding the demolition work in order to construct the new work, and is responsible to abate areas as required to perform the demolition work in accordance with the Hazardous Materials Report and applicable laws and regulations. For example, when installing power poles, ceiling tiles may need to be cut and may need to be abated since it has asbestos containing material.*

III. CHANGES TO SPECIFICATIONS

1. Table of Contents.
   - Added Communication Specification numbers and titles

2. 270000 General Communications Requirements
   - Added Specification Section.

3. 270526 Grounding And Bonding For Communications Systems
   - Added Specification Section.

4. 270528 Pathways For Communications Systems
   - Added Specification Section.

5. 270800 Commissioning Of Communications Systems
   - Added Specification Section.

6. 271100 Communications Equipment Room Fittings
   - Added Specification Section.

7. 271300 Communications Backbone Cabling
   - Added Specification Section.

8. 271500 Communications Horizontal Cabling
   - Added Specification Section.

ATTACHMENTS

1. Addendum 1 Specifications: Table of Contents, 270000, 270526, 270528, 270800, 271100, 271300, 271500.

*****END OF ADDENDUM NO. 1*****

LONG BEACH COMMUNITY COLLEGE DISTRICT

Alan Moloney, Deputy Director
Purchasing & Contracts Management

5-17-19
Date

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SECTION 270000 - GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct, racks, cabinets, termination components, ancillary equipment, testing, and labeling and documentation of cables and connectors, for a complete end-to-end solution.

B. Refer to the contract documents for locations of Telecom Rooms (TRs), Equipment Room (ER), and telecommunication outlets (TOs). Note that the port and cable count at each TO may vary by location.

C. Complete installation shall comply with the Owner provided latest telecommunication and IT standards documents.

D. It shall be the responsibility of the contractor, to work with the Owner and provide the necessary assistance to make any connections from the owners' outside plant, service provider to establish services which shall ride on the new cabling system. These activities include, but are not limited to patch cords, cross connects, general wiring, documentation, and cable pair identification.

1.2. RELATED DOCUMENTS

A. General and Supplementary Conditions

B. Long Beach City College District Standards. Liberal Arts Campus / Pacific Coast Campus.

1.3. RELATED SECTIONS

A. Division 01 – General Conditions

B. Division 07 – Penetration Firestopping

C. Division 27 - Communications

1.4. ACRONYMS AND DEFINITIONS

A. BICSI: Building Industry Consulting Service International

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection

C. EMI: Electromagnetic interference

D. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect

E. IDC: Insulation displacement connector

F. LAN: Local area network

G. NRTL: Nationally Recognized Testing Laboratory, an independent agency, with the experience and capability to conduct the testing indicated, as defined by OSHA in 29 CFR 1910.7

H. RCDD: Registered Communications Distribution Designer, a BICSI-certification

I. RMC: Rigid metallic conduit

J. TR: Telecom Room

K. UTP: Unshielded twisted pair

L. Category 6 UTP, as defined by TIA standards

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1.5. CONTRACTOR QUALIFICATIONS

A. The contractor shall be a company specializing in the installation of communication cable and accessories with a minimum of five years documented experience on similar systems.

B. Must be a current certified partner of the solutions being furnished and installed in order to meet the requirements for the extended warranty and service programs.

C. Must hold a current communications cabling license within the State the project is taking place and must be verifiable for good standing.

D. Contractor must have a current affiliation with BICSI.

E. Within the project's onsite team, 15% of installers shall hold a BICSI Installer 1 certification, 15% of installers shall also hold a BICSI Installer 2 certification (Both Optical Fiber and Copper). 10% of the team shall hold a BICSI ITS Technician certification and a minimum of (1) team member shall hold a current and valid BICSI RCDD certification.

F. All BICSI certified field installers shall take on roles of Foreman or Team Lead to ensure installations are deemed compliant per codes and standards.

G. Contractor must have satisfactorily completed (3) projects within the past 5 years of similar scope and amount within the same state.

H. The selected Contractor shall provide a Project Manager to act a single point of contact for all activities performed under this section. The Project Manager shall be a Registered Communications Distribution Designer (RCDD). The RCDD shall have a minimum of 3 years experiences in design and installation. The designer must have sufficient experience in this type project(s) as to be able to lend adequate technical support to the field forces during installation, during the warranty period and during any extended warranty periods or maintenance contracts. The Contractor must attach a resume of the responsible designer to the Contractor's submittal for evaluation.

I. The Project Manager, or designee thereof, shall be required to attend project meetings as required until project closeout/signoff.

J. Should the Project Manager assigned to this project change during the installation, the new Project Manager assigned must meet all qualifications stated in this section, and must also submit a resume for review by the Consultant.

K. If, in the opinion of the Consultant, the Project Manager does not possess adequate qualifications to support the project, the Consultant reserves the right to require the Contractor to assign a designer whom, in the Owner's opinion, possesses the necessary skills and experience required of this project.

1.6. REGULATORY REFERENCES

A. ANSI/NFPA 70

B. City of Long Beach Building Code.

C. Division of the State Architect Compliance Publications.

D. ANSI/IEEE C2 - National Electrical Safety Code (NESC)

E. NFPA 70-2011 - National Electrical Code (NEC)

F. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises, published February 2009 and all latest addenda derived from ANSI/TIA 568-B.

G. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standard, published February 2009 and all latest addenda derived from ANSI/568-B.

H. ANSI/TIA-568-C.2 – Balanced Twisted Pair Telecommunication Cabling and Components Standard, published August 2009 and all latest addenda derived from ANSI/TIA 568-B.

I. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard, published June 2008 and all latest addenda derived from ANSI/TIA 568-B.

J. ANSI/TIA/EIA 569-B - Commercial Building Standard for Telecommunications Pathways and Spaces.

K. ANSI/TIA-606-B – Administration Standard for Telecommunications Infrastructure, published June 2012 including all latest addenda derived from TIA-606-A.

L. ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

M. ANSI/TIA-758-A Customer Owned Outside Plant Telecommunications Infrastructure Standard.

N. IEEE 142 “Green Book”- Recommended Practice for Grounding of Industrial and Commercial Power Systems.

O. UL 444 - Standard for Communications Cable.

P. Rural Electrification Administration (REA) PE-89 - specification for filled telephone cables with expanded insulation.

Q. Rural Electrification Administration (REA) PE-39 - specification for filled telephone cables

R. NEC Article 250 and Article 800.

S. CEC Article 18-27-300.22©(1)

T. NEC Article 250 for System Grounding.

U. NEC Articles 770 and 800 for Cable Listing Requirements.

V. Work performed should additionally comply with and follow guidelines established in the latest edition/revision, as of the date of the Contract Documents, of the following publications:

1. BICSI Telecommunications Distribution Methods Manual (TDMM)
2. BICSI Outside Plant Design Reference Manual (OSPDRM)
3. National Electrical Contractors Association (NECA)/BICSI ANSI/NECA/BICSI-568-2006 Standard for Installing Commercial Building Telecommunications Cabling

W. All materials shall be new and listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

X. Notify Consultant of all material believed to be inadequate, unsuitable, in violation of law, ordinances, rules or regulations of authorities having jurisdiction.

1.7. CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Consultant for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits.

To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Consultant for a decision before proceeding.

1.8. SUBMITTALS

A. Submittals shall include complete documentation of the system, products and accessories in a single submittal. Incomplete submittals will be returned unreviewed.

B. Prior to the start of work the Contractor shall submit shop drawings in an electronic form. Plans shall be fresh designs by the contractor; they cannot be overlays of the Consultant's package which are indicative as the contract documents. Shop drawings shall contain:

1. Full size floor plans showing proposed cable routing, wire basket routes, labeling of all outlets, locations of pullboxes.
2. Full size floor plans and elevations of all telecommunication room racks and cabinets; also include all walls with equipment.
3. Elevations shall indicate part numbers and quantities for all equipment.
4. Elevations of all type of outlet faceplates which shall include the configuration for jacks, blanks and the intended outlet labeling schemes.
5. Floor plans shall include all ladder rack or overhead cable distribution hardware within the telecommunications rooms to be installed per manufacturer's instructions.
6. Outside plant manhole and handhole designs coordinated with electrical as well as the site environment.
7. Outside plant conduit arrangement details within ductbank and within the manholes and handholes as necessary.
8. Outside plant conduit ductbank overall routing coordinated with electrical as well as the site environment.
9. All seismic bracing and support details shall be provided in coordination with the general contractor as needed.

C. Submittals shall include faceplates mockups sent to the Consultant for final review. Mockups shall have the manufacturer's cable markings clearly visible. The following are standard items that are to be submitted.

1. Wall mounted outlet complete with faceplate, terminated jacks, blanks, and labeling for all types of outlets in project. Outlet should also contain 24" minimum of the cable proposed for the project.
2. Wireless outlet complete with jacks, blanks, and labeling.
3. Wall phone (stainless steel) outlet.
4. Modular furniture outlet complete with faceplate, jacks, blanks and labeling.
5. Raceway outlet complete with faceplate, bezel, jacks, blanks and labeling.
6. Floorbox outlet complete with faceplate, mounting plate, jacks and labeling.

D. Where applicable, dimensions should be marked in units to match those specified.

E. Work shall not proceed without the consultant's "no exception taken" of the submitted items.

F. Floor plans will be provided to the Contractor in electronic (AutoCAD, ".dwg") formats to be utilized by the contractor in creating complete submittals and as-built documentation. These modified documents shall be provided to the Owner as part of the Record Documents.

G. Plans shall be fresh designs by the contractor, they cannot be overlays of the consultant's package which is indicative as contract documents.

H. All submittal documentation shall bear the stamp of a currently verifiable BICSI RCDD.

I. Contractor must submit documentation to support all Contractor Qualifications and Requirements under Section 1.5 which is to include but not limited to the following:

1. End to end solution and partner documentation indicating contractor's staff has gone through proper channels and training support a minimum 25 year warranty and service program by the manufacturers.
2. BICSI affiliations by contractor.
3. BICSI cabling team's RCDD, Installer 1, Installer 2 (Optical Fiber and Copper) and ITS Technician certifications.
4. Current copy of the State contractor's license for Communications Cabling.
5. Documentation of (3) similar projects within the past 5 years in the same State.

J. Contractor shall include data sheets and literature of test equipment to be used for fiber and copper cabling and components.

1.9. MANUFACTURER CERTIFIED WARRANTY

A. The manufacturer shall be a company specializing in communication cable and/or accessories with a minimum of five years documented experience in producing cable and/or accessories similar to those specified below.

B. The system shall be comprised of components from a single manufacturer or a combination of manufacturers entering into a partnering agreement that allows for a warranty of the system.

C. System warranty program documents must be from that of the cabling and component manufacturer and associated partners. Cabling and component warranty programs offered by the contractor alone are not acceptable.

D. The warranty period shall be for not less than 25 years and warranty the cabling system and components will perform to the stated specifications for the warranty period.

1.10. QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

B. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

C. Requirement for specialists shall not supersede building codes and regulations governing the Work.

D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and

1.11. QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work.

D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1.12. OWNER STANDARDS

A. Work performed should additionally comply with Owner Standards.

PART 2 - PRODUCTS

2.1. NOT USED

PART 3 - EXECUTION

3.1. GENERAL

A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.

B. Contractor shall be responsible for identifying and reporting to the Site Coordinator(s) any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, pathways or other hardware must be repaired by the Contractor. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced to match color, size, style and texture.

C. The installation shall be supervised on site by a BICSI certified installer.

D. The contractor shall have on staff a BICSI certified RCDD. RCDD certification shall be current and each submittal shall bear the stamp of the RCDD.

E. Outlets shall be mounted flush on a wall-mounted box, on Surface Raceway and in Modular Furniture. Information Outlet locations are identified on Project Drawings.

F. Avoid abrasion and other damage to cables during installation. Any cable damaged during installation shall be removed and a new cable installed.

G. Cables shall be a continuous run. No in-line splices are permitted except were explicitly indicated on the drawings.

3.2. DELIVERY AND STORAGE

A. Receive, handle, and store telecommunications system items and materials at the project site. Materials and items shall be so placed that they are protected from damage and deterioration.

3.3. INSTALLATION

A. The drawings for work under Division 27 Sections related to communication systems are diagrammatic and are intended to convey the scope of work and indicate the general arrangement of conduit, boxes, equipment, termination hardware, fixtures and other work included in the Contract.

B. The Contractor shall verify all dimensions and clearances before procuring any equipment.

C. Location of items required by the drawings or specifications not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site and shall be subject to the approval of the Architect/Telecom Design Engineer.

D. Follow drawings in laying out work, check drawings of other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.

1. Where space conditions appear inadequate, the Architect/Telecom Design Engineer shall be notified before proceeding with installation.

2. Minor conduit and cable tray rerouting and changes shall be made at no additional cost to the Owner.
3. As necessary, adjust elevations of rack-mounted termination hardware and horizontal wire management panels so as to compensate for rack unit sizes of actual hardware used, as compared to hardware rack unit sizes depicted in Contract Drawings.

E. Perform all work with skilled mechanics of the particular trade involved in a neat and workmanlike manner.

F. Perform all work in cooperation and coordination with other trades and schedule.

G. Furnish other trades advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, routes for conduit and cable tray raceway, and also furnish information and shop drawings necessary to permit trades affected to install their work properly and without delay.

H. Where there is evidence that work of one trade will interfere with the work of other trades, all trades shall assist in working out space allocations to make satisfactory adjustments and shall be prepared to submit and revise coordinated shop drawings.

I. With the approval of the Architect/Consultant and without additional cost to the Owner, make minor modifications in the work as required by structural interferences, by interferences with work of other trades or for proper execution of the work.

J. Work installed before coordinating with other trades so as to cause interference with the work of such other trades shall be changed to correct such condition without additional cost to the Owner and as directed by the Architect.

K. Minor changes in the locations of outlets, fixtures and equipment shall be made prior to rough in at the direction of the Architect/Consultant and at no additional cost to the Owner.

L. Contractor shall cooperate with other trades and coordinate work so that conflicts with other work are eliminated.

M. Equipment shall be installed with adequate space allowed for removal, repair or changes to equipment. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place. Contractor shall verify measurements. Discrepancies shall be brought to the Architect/Telecom Design Engineer's attention for interpretation.

N. Determine temporary openings in the buildings that will be required for the admission of apparatus furnished under this Division, and notify the Architect/Consultant accordingly. In the event of failure to give sufficient notice in time to arrange for these openings during construction, assume all costs of providing such openings thereafter.

O. Location of telecommunication outlets and raceway pathways are approximate and exact locations shall be determined on site.

P. Contractor shall refer to contract documents for details, reflected ceiling plans, and large scale drawings.

3.4. COORDINATION

A. The Contractor shall be responsible for the coordination of telecommunications work with the work of all other trades and shall, in preparing the drawings, check the work of other trades in order to avoid possible installation conflicts arising therefrom. It shall be understood that the work shown on the shop drawings has been so coordinated. In the event of conflicts or interference that cannot be resolved in the field, the Contractor shall request a written clarification from the Architect/Consultant.

B. Coordinate service entrance arrangement with local exchange carrier(s).

1. Meet jointly with local exchange carrier representatives and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute to other participants.
3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

C. Where work covered by this Section connects to equipment furnished under other Sections, verify telecommunications work involved in the field and make proper connection to such equipment.

END OF SECTION 270000

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes grounding and bonding of all passive and active equipment supplied by contractor and owner.

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

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

1.3. RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4. RELATED SECTIONS

A. Division 27 - Communications

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, “Grounding and Bonding for Electrical Systems.”

2.2. GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section “Conductors and Cables.”

B. Communications Copper Bonding Conductors: As follows:

1. Telecommunications Bonding Conductor (TBC) and Telecommunications Bonding Backbones (TBB): No. 3/0, stranded copper conductor, insulated.
2. Telecommunications Equipment Bonding Conductor (TEBC): No. 6 AWG, stranded copper conductor, insulated.

2.3. CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.4. COMMUNICATIONS OUTSIDE PLANT DUCTBANK, HANDHOLE AND PULLBOX GROUNDING

A. The reinforcing steel in the walls of the handholes and manholes shall be bonded together and brazed to the bronze inserts of each section per the manufacturer’s specifications. The

ground inserts shall be attached to the steel rebar to provide a point of attachment for the ground wires of bonding ribbon. The inserts shall be bronze, flush mounted, and brazed to the rebar cage of all the sections for the handhole and pullbox.

B. Materials:

1. Bonding Ribbon: Shall be made of annealed solid copper 3/8 inch wide x 1/16 inch thick, tin plated. Provide: INWESCO Cat. 12A55, or equal subject to review.
2. Bonding Ribbon Clamp: Shall be made of soft lead ½ inch wide by 1/6 inch thick and shall accept ¼ inch diameter bolt. Provide: INWESCO Cat. 12A56, or equal subject to review.
3. Fargo Clamp: Shallbe cast from copper, silver plated, furnished with copper bolt. Provide: INWESCO Cat. 12A57, or equal subject to review.
4. Ground Inserts: Shall be made of Cast Bronze W/14 Copper Rod. Provide: INWESCO Cat. 12H69, or equal subject to review.

2.5. TELECOMMUNICATIONS GROUNDING BUSBAR

A. Comply with ANSI/TIA-607-B.

B. Telecommunications Main Grounding Busbar (TMGB): Electro-tin plated copper, minimum 1/4 inch thick by 4 inches wide by minimum 20” long, with holes sized, spaced and in minimum quantities as follows:

1. 5/16” holes at 5/8” spacing, minimum quantity of 27
2. 7/16” holes at 1” spacing, minimum quantity of 3
3. Provide longer TMGB as necessary to accommodate quantity of actual bonding connections required in field.

C. Telecom Grounding Busbar (TGB): Electro-tin plated copper, minimum 1/4 inch thick by 2 inches wide by minimum 12” long, with holes sized, spaced and in minimum quantities as follows:

1. 5/16” holes at 5/8” spacing, minimum quantity of 6
2. 7/16” holes at 1” spacing, minimum quantity of 3
3. Provide longer TGB as necessary to accommodate quantity of actual bonding connections required in field, per communications room.

PART 3 - EXECUTION

3.1. INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bond metallic raceways used for routing of communications bonding conductors, to the communications bonding conductor at each end.

3.2. CONNECTIONS

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

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Equipment Grounding Conductor Terminations: Use pressure-type grounding lugs.

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

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

3.3. TELECOMMUNICATIONS GROUNDING AND BONDING

A. Comply with NEC, ANSI/TIA-607-B and UL 467.

B. Comply with telecommunications ground details and riser diagrams in Contract Drawings.

C. Telecommunications Grounding Busbars: TMGB and TMB within facility to provide for telecommunications grounding system.

1. Locate grounding terminals in each telecommunications room.
2. Mount on wall of telecommunications entrance facility, equipment room, and closet, with standoff insulators.

D. Bonding Conductors:

1. Extend a TBC from TMGB to electrical entrance facility and connect to grounding electrode system.
2. Extend a TBB from TMGB to each TGB.
3. Extend a TEBC from TGB to ground terminals at communication relay racks, wall-mount communication racks and cabinets, primary protection blocks, overhead ladder rack runway systems and cable basket tray systems.

E. Special Requirements:

1. Bonding conductors shall be insulated copper, sized as noted in Contract Drawings.
2. Bonding conductors shall be installed without splices unless as noted in telecommunications grounding riser diagram, or as approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible. Splices shall be by irreversible compression connectors or by exothermic welding.

F. Primary Protectors

1. Primary protectors shall be installed on each cable end, in the appropriate building entrance protector.
2. Primary protector enclosure shall be bonded to the building grounding system utilizing a minimum #6 AWG ground wire.

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

END OF SECTION 270526

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SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. This includes pathways for distribution and protection of cabling and components.

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467.

C. General Requirements: Comply with ANSI/TIA-569-B.

D. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.
4. Bridle rings not permissible unless furnished with cable saddles.

1.3. RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4. RELATED SECTIONS

A. Division 27 – Communications

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by approved manufacturers listed in Division 26 section, “Grounding and Bonding for Electrical Systems.”

2.2. CONDUIT AND ELECTRICAL BOXES

A. Comply with requirements in Division 16 Section “Raceways and Boxes.” Flexible metal conduit shall not be used, except as indicated in Contract Drawings. Coordinate with layout and sizing details and requirements as indicated in Contract Drawings.

1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high and 2-1/8 inches deep.
2. Minimum conduit to telecom outlet locations: Trade Size 1-1/4”, unless otherwise noted in Contract Drawings

2.3. COMMUNICATIONS OUTSIDE PLANT HANDHOLE AND PULLBOXES

A. Materials:

1. All handholes and pullboxes to be installed shall be specifically designed for telecommunications applications, with no exceptions.

2. The contractor shall provide pre-cast utility vaults meeting ASTM C 478 with 28 day 5500 psi minimum compressive strength concrete and designed for AASHTO H-20 loading per AASTO HB 14. See outside plant drawings for sizes.
3. Utility handholes shall have tongue-and-grove double sealed joints on mating edges of pre-cast components. The joints shall firmly interlock adjoining components and provide waterproof junctions and adequate shear transfer. Joints shall be sealed with approved watertight joint sealant as prescribed in the manufacturer's installation specifications and conforming to AASHTO M198, Type B. Sealing material shall be installed in strict accordance with manufacturer's printed instructions.
4. Conduit entrances:
    a. For conduit installed on this project, knockout panels or pre-cast individual conduit openings may be used.
    b. For existing utility vaults, new ducts shall enter the utility vault with factory-formed bell end of the conduit, and a seal around the conduit shall be applied after installation. Existing utility vaults that shall be re-used to install new copper and fiber cables shall be retrofitted with the required racking and grounding and bonding per TIA Bonding and Grounding Standards.
5. Handholes and pullboxes shall be equipped with a minimum of approved cable racking on one long wall suitable to support large copper cables as called for on the design documents.
6. All handholes and pullboxes as shown on the plans shall be equipped with non-skid surface traffic rated spring loaded hinged lids with a locking mechanism.
7. All lids shall have the identification marking of "Communications" permanently affixed to the cover. The upper side of each cover shall have the letters "Communications" cast or burned by welder, in integral letters no less than 2 incheck high. The cover shall also be field stamped with two inch high pullbox identification numbers determined with the College as final on site.

B. Provide: Jensen Precast, Utility Vault Company, or equal subject to review.

2.4. COMMUNICATIONS OUTSIDE PLANT HANDHOLE AND PULLBOX HARDWARE

A. Materials:

1. Pulling irons shall be provided, as required for the size of handhole and pullbox (minimum of 4: 2 installed on each end wall, top and bottom). Pulling irons shall be installed opposite the terminators. All pulling irons shall be constructed of 2.2 cm (7/8 inch) hot-dip galvanized steel.
2. A sump of 30cm (12 in.) in diameter shall be provided in each handhole and pullbox per the manufacturer's specifications.
3. Heavyweight cable racks with adjustable arms shall be provided for all cables in each utility vault. The racks shall be attached with adjustable inserts set in the concrete wals (bolts or studs embedded in concrete will not be used). Racks and inserts shall be centered on the side walls that are utilized for the racking of splice cases in the handhole or pullbox, arranged so that all spare conduit ends are clear from future cable installation. The racks shall have a sufficient number of arms to accommodate cables for each conduit entering or leaving the utility vault.
4. Corner standoff brackets 15cm to 20cm (6 inches to 8 inches from wall) shall be provided if the handhole and pullbox is equipped with center exit conduits. The bracket shall extend from 15cm (6 inches) off floor to 15cm (6 inches) below roof.
5. All handhole and pullbox hardware shall be steel that is hot dip galvanized after fabrication.

B. Provide: Alhambra Foundry (Model No. A-3362 ladder with A-3382 support bar), Inwesco Products, or equal subject to review.

2.5. COMMUNICATIONS OUTSIDE PLANT DUCTBANKS

A. Materials:

1. Conduit – Schedule 40 PVC.
2. Conduit shall have factory formed bell on one end for interconnecting sedments.
3. All conduits shall be installed in an encased steel pipe where boring method is utilized. Grout shall be provided between conduits inside pipe and around steel pipe to fill voids per manufacturer's specifications.
4. Spacers: High impact spacers shall be used in all multi-duct systems. They shall conform to NEMA TC-2, TC-6, TC-8 and ASTM F 512 dimensions.
5. All fittings shall be designed specifically for use with the type of installed conduit.
6. All conduits shall be equipped with seal plugs in all handholes and pullboxes and expansion rubber seal plugs within all buildings.
7. Provide orange dye along entire length of ductbank concrete shell.

B. Provide: Carlon, Jack Moon, or equal subject to review.

2.6. COMMUNICATIONS OUTSIDE PLANT DUCTBANKS

A. Warning tape shall be a minimum of 3" wide, orange in color, and shall have a non-degradable imprint as follows.

1. "Caution Telephone Cable Buried Below"
2. "Caution Fiber Optic Cable Buried Below"

B. Provide: Carlon MAT3T61, MAT3061, or equal subject to review.

2.7. WIRE BASKET CABLE TRAY (CISCO NETWORKING AND CABLING LABS):

A. Wire basket cable tray shall have the following characteristics:

1. Minimum 12" wide and 4" deep unless otherwise noted.
2. Galvanized steel finish.
3. Provide all accessories for achieving cable bend radius including but not limited to waterfall units and radius at turn junctions.
4. Provide GS Metals, Flextray, B-Line or equal subject to review.

2.8. SOLID BOTTOM CABLE TRAY (STANDARD HORIZONTAL PREMISE CABLING):

A. Solid bottom cable tray shall have the following characteristics:

1. Minimum 18" wide and 3" deep unless otherwise noted.
2. Galvanized steel finish.
3. Tray must be able to be painted or powered coated the same color and material as neighboring in ceiling utilities.
4. Cable must be protected during painting to where it does not get stained. Paint on cable may be bounds for voiding solution warranty.
5. Provide B-Line, Homaco, Square D, or equal subject to review.

2.9. J-HOOKS

A. Must me metal construction and shall provide a cable support hanger in a "J" configuration designed to support multiple communications cables.

B. No more than twelve (12) station cables may be supported by a single hanger without using a saddle (3 inches wide at a minimum) to support the weight of the additional cables.

C. Larger types of wire hangers (larger J-hooks or Tri-hooks) are acceptable for locations requiring more than twelve cables. Copper and fiber cables must be properly installed per manufacturer's specifications to insure maximum cable performance.

D. Provide: CPI Chatsworth Products Inc., Cooper B-line, Caddy or equal subject to review.

2.10. LADDER RACK

A. Cable runway shall be ladder type and designed for use in telecommunications rooms.

B. Cable runway shall be aluminum construction, minimum 12” wide and 1.5” side rails.

C. Provide all parts and pieces to create a continuous pathway for cables within telecommunication rooms. Provide parts to support cable continuously from the sleeves entering the TR to the equipment racks and backboards.

D. Finish should be powder coated, black.

E. Provide: CPI Chatsworth Products Inc., Cooper B-line, Homaco or equal subject to review.

2.11. FLEXIBLE NON-METALLIC INNERDUCT (PLENUM AND RISER)

A. Innerduct shall be corrugated plastic.

B. Nominal duct size shall be minimum 1-inch.

C. Innerduct shall be riser, plenum, or OSP rated as required by the installation environment.

D. Provide: Carlon, Vickmatic Plenum Duct or equal subject to review.

2.12. INNERDUCT (OUTSIDE PLANT)

A. Interbuilding fiber cables in underground ductbanks shall be installed in MaxCell innerducts.

B. Innerduct shall be fabric type with three (3), 3 inch diameter cells unless otherwise notes on the drawings.

2.13. CABLE TIES

A. Bundle and support all cables and to provide a neat and orderly cabling installation.

B. Velcro tie wraps shall be used in MDF and IDF Rooms. Zip ties and wraps that cannot be adjusted once installed are not acceptable.

C. Provide: Velcro, T&B, Hellerman Tyton or equal subject to review.

2.14. DISTRIBUTION RINGS (D-RINGS).

A. Must be used to support and dress out cables on plywood backboards vertically and horizontally. Cables shall not be supported by cable ties alone on backboard.

B. Individual D-rings shall be sized to allow a minimum of 50% spare capacity for future cable installation.

PART 3 - EXECUTION

3.1. GENERAL

A. Cable shall be neatly dressed out in telecom rooms.

B. Secure cabling with Velcro type cable wraps only.

C. Install distribution rings on plywood backboards to support cables.

3.2. CABLE TRAY

A. Install cable trays level, straight, and parallel to walls.

B. Support cable trays minimum every 5 feet.

C. Install cable tray system with 12 inches clearance measured from top most surface of tray. Access from sides shall be 6 to 12 inches. Install with 12 inches clearance measured from bottom of tray.

D. Remove burrs and sharp edges from cable trays.

E. Cut cable tray wires in accordance with manufacturer's instructions.

F. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.

G. Provide conduit to tray fitting at each conduit entrance to tray.

H. Ground cable trays according to manufacturer's written instructions.

I. Cable trays shall not pass through any firewall or fire-rated soffits without proper firestop pillows per applicable codes.

J. Provide necessary supports and accessories for cable trays as required to make a complete job.

3.3. LADDER RACK

A. Provide dropouts at all equipment rack and backboard locations.

B. Install straight, level and perpendicular to walls and ceiling.

C. Install 3" to 6" above racks.

D. Cables shall be secured to the runway using reusable cable ties to arrange cable in logical bundles.

E. Ground cable runway according to manufacturer's written instructions.

3.4. J-HOOKS

A. Provide J-hooks to support communications cables at locations where cable tray and/or conduit is not provided.

B. Provide J-hooks assemblies on 4-foot intervals to support all outlet cables. Install J-hooks approximately 12 inches above lay-in ceiling. Use J-hooks to support not more than 50 cables per hook. Provide additional hooks in rows as requi9 to support more than 50 cables.

C. Individual J-hooks shall be a minimum of 1" in width and sized and arranged to allow a minimum of 50% spare capacity for future cable installation.

D. Secure J-hooks to concrete slab using threaded expansion anchor bolts. Drill slab and install expansion bolt.

E. Coordinate location with HVAC duct and lights. Do not install above fluorescent lighting fixtures.

3.5. FLEXIBLE NON-METALLIC INNERDUCT

A. Innerduct segments shall be spliced using couplings designed for that purpose.

B. All vacant innerduct shall be equipped with a pull cord and capped at both ends.

C. Innerduct shall extend to the ladder rack above the termination enclosure.

D. All exposed innerduct shall be labeled at 50-foot intervals with tags indicating the cable type it contains.

END OF SECTION 270528

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SECTION 270800 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a testing, documenting, and commissioning of an operable end to end structured cabling system.

B. Complete installation shall comply with the campus or owner's latest telecommunication and IT standards documents.

1.2. RELATED SECTIONS

A. Division 27

1.3. PROJECT AS-BUILT AND CLOSEOUT DOCUMENTS

A. Accurately record exact sizes, locations, heights and quantities of cables and Information Outlets.

B. As-built drawings shall indicate all final cable routes and final outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

C. Drawings shall indicate final TR & ER locations along with their final build out conditions at end of the project.

D. Submit bound folders of product used in the project for record.

E. Submit cable tester calibration reports.

F. Submit all copper and fiber optic test results as indicated in Part 3 of this specification. This should include every cable channel installed in the project.

G. Plans shall be provided in full size PDF, AutoCAD or REVIT format within a CD or DVD along with hard copies.

PART 2 - PRODUCTS

2.1. NOT USED

PART 3 - EXECUTION

3.1. GENERAL

A. Contractor shall follow standard industry installation practices as described in the latest release of the BICSI TDMM.

3.2. IDENTIFICATION AND LABELING

A. All backbone and station cables, faceplates and termination components shall be clearly labeled in accordance with EIA/TIA 606-B.

B. The Contractor shall obtain the labeling scheme from the Owner.

C. Labels strips shall be covered with a protective plastic coating. Labels shall be machine printed. No handwritten label shall be accepted. Stick-on labels are not acceptable.

D. Components

1. The labeling made for each component should be:

   a. Unique, to prevent confusion with similar components.
   b. Legible and permanent enough to last the lifecycle of the component.
   c. The following infrastructure components should be labeled:

      1) Telecommunications spaces
      2) Telecommunications pathways
      3) Telecommunications cables
      4) Zone boxes
      5) Connecting hardware
      6) Grounding (earthing) system

E. Telecommunications spaces

1. Telecommunications spaces include:

   a. Equipment rooms (ERs)
   b. Telecommunication rooms (TRs)
   c. Telecommunication enclosures (TEs)
   d. Work areas

2. Spaces should be labeled at their entrances, as follows:

   a. In small, single-story buildings, a simple sign on the door is sufficient.
   b. In larger buildings, the labeling should provide a unique identifier, since there may be a number of telecommunications spaces.

F. Telecommunications pathways

1. Labeling of pathways helps prevent inadvertent installation of cables from systems that may interfere with each other.
2. When labeling pathways, the following guidelines should be met:

   a. Labeling should be affixed at the ends of each pathway.
   b. Pathways should be labeled at regular intervals and wherever they are accessible.
   c. In a basic system, the conduits should be marked from the main ER by painting or using a permanent-colored tape-wrap made for this purpose.
   d. In systems utilizing zone boxes for consolidation or distribution of low-voltage systems, each box label should include the information about the room of origin and system usage.
   e. In complex systems or large buildings:

      1) A striped tape should wrap pathways with the base color identifying them as telecommunications pathways and tracer color identifying the individual uses.
      2) Each pathway should be assigned a unique alphanumeric identifier.
      3) All wall or floor penetrations should be labeled.

3. Telecommunications cables

   a. When labeling telecommunications cables:

      1) Cables should be identified at each end with a permanent label or physical/electronic tag. The same alphanumeric identifiers should be used at both ends of the cable.
      2) Cable should be identified at regular intervals throughout its length with its alphanumeric identifier when cables are rearranged, rerouted, or removed in spite of the added cost.

b. In systems that are:

1) Basic, the labeling scheme can be a simple number sequence.
2) Complex, the labeling may indicate the type, function, and terminating position.

G. Connecting hardware

1. Connecting hardware items (e.g., cross-connect fields and telecommunications outlet/connectors) require a unique, alphanumeric identification such as the following three-level scheme:

a. First level – Termination field or patch panel. Color-coding or other labeling should be used to uniquely identify each termination field on a common mechanical assembly.
b. Second level – Terminal block within a given field or patch panel, which could be a row of insulation displacement connectors (IDCs), optical fiber connectors, or modular jacks.
c. Third level – Defines the individual position within a given terminal block or patch panel.

H. Grounding (Earthing)

1. Grounding system components (e.g., ground bars and grounding conductors) require special labeling for safety and noise control purposes and for simplifying and expediting ground system audits.
2. All equipment grounding conductors should be labeled to indicate the:

a. Grounded rack, cabinet, or shelf.
b. Ground bar to which the grounding conductors are connected.

3. Each grounding conductor in a building should be labeled, including those connecting building steel, grounding electrodes, water pipes, radio towers, and telecommunications structural components.

3.3. TESTING AND COMPLIANCE

A. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Testing shall be executed by technicians holding proof of successful installation certification from the system manufacturer.

B. Cable testers are to be calibrated within four (4) months of use.

C. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type including equipment to use, set-up, test frequencies or wavelengths, results format, etc.

D. 100% of the installed cabling links must be tested in accordance with ANSI/TIA/EIA-568-B standard and must pass the requirements described under the heading for each cable type. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.

E. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.

F. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Owner. Representatives of the Owner shall be invited to be in attendance to witness the test procedures. The contractor shall provide a minimum of one (1) week advance notice to the

Engineer as to allow for such participation. The notification shall include a written description of the proposed conduct of the tests including copies of blank test result sheets to be used.

G. A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing commences. A representative of the Owner reserves the right to select a random sample of up to 5% of the installed links for retesting. The Contractor shall re-test these randomly selected links and the results are to be stored in the tester. The results obtained shall be compared to the original test data provided by the Contractor. If more than 2% of the sample pass/fail results differ from the original test data, the installation contractor under supervision of the Owner's representative shall repeat 100% testing and the cost shall be borne by the Contractor.

3.4. CABLING ADMINISTRATION DRAWINGS

A. Prepare Cabling Administration Drawings showing building floor plans with cable administration-point identification labeling. Depict all telecommunications outlets and their associated label, provide callouts indicating locations of telecom rooms and spaces and, where applicable, indicate zone line demarcations denoting areas served by each respective telecom room. Coordinate drawing features with shop drawing requirements outlined in Section 270000.

B. Prepare Drawings for use as part of cabling installation work. Periodically update Drawings to reflect constructed conditions, including any moves, changes or additions to the communications infrastructure. At completion, Cabling Administration Drawings shall reflect as-built conditions.

C. Interim Submission: Issue two (2) half-size printed copies of in-progress draft Cabling Administration Drawings to Owner no later than five (5) weeks prior to Substantial Completion, for Owner's use in preparation of patch schedules and to support other internal move-in planning processes. Coordinate exact timing with Owner's IT personnel.

3.5. TEST RESULTS DOCUMENTATION

A. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The test result records saved by the tester shall be transferred into a spreadsheet or database that allows for the maintenance, inspection and archiving of these test records. Provide the database for the completed job on CD-ROM. If the results cannot be viewed by Microsoft Excel or Microsoft Access, the Contractor shall provide one licensed copy of a software package suitable to view and print reports of the test results.

B. Upon completion of the installation, the contractor shall provide three (3) full electronic documentation sets to the Consultant for approval.

C. Documentation shall be submitted within ten (10) working days of the completion of the testing phase. This includes draft as-built drawings. Draft drawings may include annotations done by hand.

D. Machine generated final copies of all drawings shall be submitted within 30 working days of the completion of the testing phase. Final copies shall have all annotations in CAD format.

E. All documentation, including hard copy and electronic forms shall become the property of the Owner.

F. A paper copy of the test results shall be provided that lists all the links that have been tested along with the following summary information:

1. The identification of the customer site as specified by the end-user.
2. The identification of the link in accordance with the naming convention defined in the overall system documentation.
3. The overall Pass/Fail evaluation of the link-under-test.

4. The date and time the test results were saved in the memory of the tester.

G. The following information shall be provided in the electronic database of the test results information for each link:

1. The identification of the customer site as specified by the end-user.
2. The identification of the link and/or fiber in accordance with the naming convention defined in the overall system documentation.
3. The overall Pass/Fail evaluation of the link-under-test.
4. The date and time the test results were saved in the memory of the tester.
5. The name of the standard selected to execute the stored test results.
6. The cable type and the value of NVP or index of refraction used for length calculations.
7. The brand name, model and serial number of the tester.
8. The identification of the tester interface.
9. For fiber tests, the identification of each link/fiber in accordance with the naming convention defined in the overall system documentation
10. For fiber tests, the insertion loss (attenuation) measured at each wavelength, and the test limit calculated for the corresponding wavelength.
11. For fiber tests, the link length shall be reported for each optical fiber for which the test limit was calculated based on the formulas above.
12. The revision of the tester software and the revision of the test standards database in the tester.

H. The test results information must contain information on each of the required test parameters in accordance with the descriptions above. For each of the frequency-dependent test parameters, the value measured at every frequency during the test shall be reported.

3.6. CATEGORY 6 CABLING

A. The test parameters for cat 6 are defined in TIA Cat 6 standard, which refers to the ANSI/TIA-568-C.2 standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

B. The test equipment (tester) for cat 6 cabling shall comply with the accuracy requirements for the proposed level III field testers as defined in the TIA Cat 6 Document. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration are specified in Table B.2 of Annex B of the TIA Cat 6 Standard.

C. The following parameters shall be tested for each cable:

1. Length – The length of the cable shall be defined as the length of the pair with the shortest electrical length.
2. Wire Map – The wire map shall indicate continuity to the remote end for all conductors; identify any shorts between conductors; and identify transposed, reversed or split pairs. Any incorrect parameters shall be corrected.
3. Insertion Loss – Insertion loss shall be measured in decibels (dB) and tested in a maximum step size of 1 MHz. All of the test points shall be provided in the test results.
4. Near End Crosstalk (NEXT) – NEXT shall be measured on each wire pair combination from each end of the link for a total of 12 pair combinations. The maximum step size shall not exceed the parameters in Table 1.
5. Power Sum NEXT (PSNEXT) – PSNEXT shall be measured on each wire pair from each end of the link for a total of 8 measurements. The maximum step size shall not exceed the parameters in Table 1.

6. Equal Level Far End Crosstalk (ELFEXT) – ELFEXT shall be measured on each wire pair combination from each end of the link for a total of 24 pair combinations. The maximum step size shall not exceed the parameters in Table 1.
7. Power Sum ELFEXT (PSELFEXT) – PSELFEXT shall be measured on each wire pair from each end of the link for a total of 8 measurements. The maximum step size shall not exceed the parameters in Table 1.
8. Return Loss – Return loss shall be measured on each wire pair from each end of the link for a total of 8 measurements. The maximum step size shall not exceed the parameters in Table 1.
9. Propagation Delay – Propagation delay shall be measured on each wire pair for a total of 4 measurements.
10. Delay Skew – Delay skew shall be defined as the difference between the fastest and slowest pairs in a cable.

Table 1

Frequency Range (MHz)	Maximum Step size (MHz)
1 – 31.25	0.15
31.26 – 100	0.25
100 – 250 (Cat 6 only)	0.50

3.7. CABLE TESTING

A. Backbone Voice cables shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity and conductor position on the termination blocks. Any incorrectly positioned pairs must be identified and corrected. The percentage of “bad” pairs shall not exceed 3% in any backbone cable based on total pair count. All bad pairs must be identified and documented.

B. The Contractor shall be responsible to test the entire system from each voice outlet to the building Main Crossconnect (MC). If more than a 1% failure on the cross-connects occur the contractor will be required to provide mapping of the system.

3.8. FIBER OPTIC CABLE TESTING

A. Every fiber optic cabling link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-B.

B. ANSI/TIA/EIA-568-B, defines the passive cabling network, to include cable, connectors, and splices, between two optical fiber patch panels. A typical horizontal link segment is from the telecommunications outlet/connector to the horizontal cross-connect. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.

C. 100% of the installed cabling links shall be tested. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.

D. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by the manufacturer of the fiber optic cable and/or the fiber optic connectors or the manufacturer of the test equipment used for the field certification.

E. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14A. The light source shall meet the launch requirements of ANSI/EIA/TIA-

455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap with a Category 1 light source.

F. Field test instruments for single mode fiber cabling shall meet the requirements of ANSI/EIA/TIA-526-7.

G. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

H. The fiber optic launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.

I. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.

J. ANSI/TIA/EIA standard 568-B prescribes that the single performance parameter for field testing of fiber optic links is insertion loss. The insertion loss shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B:

1. Link Attenuation = Cable_Attn + Connector_Attn + Splice_Attn
2. Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)
3. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation Coefficient (dB/km)
Multimode 50/125 µm	850	3.0
	1300	1.0
Single-mode (Inside plant)	1310	0.5
	1383	0.5
	1550	0.5
Single-mode (Outside plant)	1310	0.5
	1383	0.5
	1550	0.5

4. Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)
5. Maximum allowable individual connector_loss = 0.75 dB
6. Splice_Attn (dB) = number of splices (S) * splice_loss (dB)
7. Maximum allowable splice loss = 0.3 dB

K. Additional 40GB/100GB requirements for multimode fiber:

1. Maximum MPO and individual connector loss = .35 dB.
2. Maximum total connector loss per 150 meters = 1dB
3. Maximum total channel insertion loss per 150 meters = 1.5dB

L. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

M. Link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1

N. The acceptable link attenuation for a multimode horizontal optical fiber cabling system is based on the maximum 90 m (295 ft) distance. The horizontal link should be tested at 850 nm or 1300 nm in one direction in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper. The horizontal link shall be tested using a fixed upper limit for attenuation of 2.0 dB.

O. Multimode backbone links shall be tested in one direction at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A. The link attenuation equation above shall be used to determine limit values.

P. Single mode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper. All single mode links shall be certified with test tools using a Category 2 laser light sources at 1310 nm and 1550 nm.

3.9. WARRANTY

A. The Contractor shall guarantee all materials, equipment, etc., for one year from date of substantial completion of this work. This guarantee shall include all labor, material and travel time. This warranty is in addition to the cabling system manufacturer’s warranty.

END OF SECTION 270800

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end structured cabling system. Including equipment for the Telecom Rooms.

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3. RELATED DOCUMENTS

A. General and Supplementary Conditions

1.4. RELATED SECTIONS

A. Division 27 - Communications

PART 2 - PRODUCTS

2.1. MANUFACTURER(S) AND SOLUTIONS

A. Acceptable manufacturers:

1. CPI Chatsworth Products Inc.

2.2. EQUIPMENT RACK

A. Standard Floor-Mounted 19” Rack: Aluminum or steel construction, freestanding, modular, with top and bottom angles.

B. Rack shall be 84" high and accommodate industry standard 19” wide mounting brackets.

C. Rack shall incorporate a universal 5/8"-5/8"-1/2"alternating hole pattern.

D. Rack rails shall be threaded and tapped to accept industry standard #12-24 mounting screws.

E. Rack should be supplied with a ground bar and #6 AWG Ground lug.

F. Equipment Rack shall be equipped with cable management hardware to provide for orderly and secure routing of cabling. Provide cable management as described in the specifications and drawings.

2.3. HORIZONTAL CABLE MANAGEMENT

A. Horizontal cable manager shall be slotted duct with removable cover. Manager shall be a minimum of 2 rack units high and suitable for mounting in a standard 19” wide rack.

B. Provide strain relief and cable management at the rear of each manager unit for clean routing of all cables.

C. Management shall be Black in color.

2.4. VERTICAL CABLE MANAGEMENT

A. Vertical cable manager shall be slotted duct with removable cover. Wires should be held in place after cover is removed. Finger spacing shall be on 1U centers. Manager shall have integral cable pass thru holes for ease of front to back cabling. Management shall be provided for front and back of rack.

B. Management shall be side mounted on both sides of each rack and/or cabinet as shown on drawings.

C. Length of management shall match overall height of rack and 6” minimum width unless otherwise noted.

D. Management shall be Black in color.

2.5. VERTICAL CABLE MANAGEMENT (CISCO NETWORKING AND CABLING LABS)

A. Vertical management for (12) existing total 2-post racks to be moved in from existing labs.

B. Provide CPI Chatsworth Products Inc.

C. Vertical cable manager shall be slotted duct with removable cover. Wires should be held in place after cover is removed. Finger spacing shall be on 1U centers. Manager shall have integral cable pass thru holes for ease of front to back cabling. Management shall be provided for front and back of rack.

D. Management shall be side mounted on both sides of each rack and/or cabinet as shown on drawings.

E. Length of management shall match overall height of rack and 6” minimum width unless otherwise noted.

F. Management shall be Black in color.

2.6. TELECOMMUNICATIONS PLYWOOD BACKBOARD

A. Backboards shall be 4’W x 8’H x ¾”D, finished grade.

B. All sides of each backboard should be painted with two coats of white fire retardant paint prior to installation.

C. If the local authority having jurisdiction of fire code requires fire-rated plywood, then UL listed fire retardant plywood should be utilized and painted with white fire retardant paint prior to installation.

D. A fire retardant paint additive may be used and the associated documentation should be applied to the painted backboard as proof of usage.

2.7. POWER DISTRIBUTION UNIT (PDU) IN CISCO NETWORKING LAB #QQ219

A. PDU inlet cord shall include the appropriate plug deemed necessary (e.g. 5-20P) per the electrical drawings. Refer to the electrical drawings for more information on plug type for dedicated power receptacles above the equipment racks and cabinets or elsewhere in the room.

B. Inlet cord shall be a minimum 12 feet in length.

C. PDU shall include a minimum of (16) switched NEMA 5-15R/5-20R power outlets for equipment connections.

D. PDU shall have metered and switched functionality.

E. Each outlet on PDU shall support power-on, power-off and reboot on a real-time programmable basis.

F. Unit shall allow reporting of voltage, frequency & load level, and current via Ethernet interface. Notifications of conditions are to be reported by email, secure web, SNMP, Telnet or SSH interface.

G. PDU shall provide Transient suppression to avoid overloads per the wattage rated by the PDU overall and by the individual power outlets.

H. PDU shall be rack mountable, no more than 1 rack unit in height for horizontal mounted condition.

I. UL-1449, UL 1283 and UL-497A compliant.

J. Power strip shall meet or exceed IEEE 587 Category A & B specifications.

K. One (1) PDU shall be furnished and installed in each rack within the room.

L. Provide Tripp-Lite PDUMH20NET or equal subject to review.

2.8. WALL MOUNTED PATCH CORD CABLE CADDY IN CISCO NETWORKING LAB #QQ219

A. Provide Pomona Electronics Test Lead Holder #1508.

B. Provide a total of (6) units. Each set of (3) units shall be installed on the north and south side of the room. Refer to Architectural drawings for locations.

C. Maintain 36” minimum clearance in front of the cable caddies.

PART 3 - EXECUTION

3.1. EQUIPMENT RACK

A. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. Rack shall also be stabilized by extending a brace to the wall. Alternately, overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.

B. Install rack with 4” side clearance from walls. Provide minimum clearances as shown on Drawings. Locations where these guidelines cannot be followed should be brought to the attention of the Consultant prior to installation.

C. Install with a minimum of 36 inches clear access behind and in front of rack unless otherwise directed by drawings.

D. Install racks straight and perpendicular to walls.

E. All hardware and equipment shall be mounted above 18" and below 79" A.F.F.

F. The rack shall be grounded to the telecommunications ground bar (TGB) using a minimum #6 AWG insulated stranded copper conductor. Conductor jacket shall be green.

3.2. WIRE MANAGEMENT

A. Rack shall be equipped with vertical and horizontal wire management hardware.

B. Provide horizontal cable management hardware below each patch panel.

C. Provide vertical cable management hardware on front and rear of each rack. Where multiple racks are installed, troughs shall be mounted between the uprights of adjacent racks per manufacturer recommendations.

3.3. BACKBOARDS:

A. Install backboards 6” above the finished floor to 8’6” AFF. Mounting shall be sufficient enough to support the equipment.

B. Shall be mounted with a minimum of 3/8” toggle bolts and 2” fender washer on each corner and 4’ on center as required.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end backbone structured cabling system throughout the campus and premises. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct and termination components, ancillary equipment, testing, labeling and documentation of cables and connectors.

B. Complete product procurement and installation shall comply with the campus or owner's latest telecommunication and Information Technology standards documents.

C. Provide 25 pair copper, minimum per building and at every communication manhole location.

D. Provide 48 strand of single mode fiber and 12 strand of multi-mode fiber cable per each building (no hybrid fiber).

E. Provide minimum of 24 strand single mode fiber and 6 multi-mode fiber between IDF & BDF within the building.

F. Provide minimum 6 pair copper for interbuilding copper cabling

PART 2 - PRODUCTS

2.1. MANUFACTURER(S) AND SOLUTIONS

A. Acceptable backbone voice copper (interbuilding and intrabuilding) manufacturers:

1. General Cable.

B. Acceptable fiber optic (interbuilding and intrabuilding) manufacturers:

1. Corning LANscape.

2.2. BASIC ENVIRONMENTAL REQUIREMENTS

A. Cabling shall be suitable for environment in which they are to be installed.

B. Cabling shall be plenum-rated within interior premise installations.

C. Cabling shall be outdoor rated within exterior installations subject to outdoor environmental conditions.

2.3. INTRABUILDING COPPER CABLING (VOICE)

A. Backbone Cable shall incorporate 24 AWG solid annealed copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene. Conductors shall be twisted to form pairs and fully color-coded. Cable shall be available in 25, 50, 100, 200 or more pairs.

B. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with the latest ICEA publication of S-80-576.

C. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair sub-units. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.

D. The cables shall contain an overall corrugated, coated aluminum shield that is electrically continuous over its entire length.

E. Provide one full 500-foot spool of 24-AWG two-pair jumper wire on a spool holder for additional cross connects by owner.

2.4. INTERBUILDING COPPER CABLING (VOICE)

A. Cables shall incorporate 24 AWG solid, annealed, bare copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene.

B. Conductors shall be twisted to form pairs and fully color-coded. Cable shall be available in 25, 50, 100, 200 or more pairs.

C. Cables shall be designated RUS/REA PE-89 suitable for duct or direct burial applications. Cables shall be Aluminum Steel with Polyethylene (ASP) filled core cables.

D. Conductors shall be insulated with a thermoplastic skin. Maximum diameter of the insulated conductor shall be 0.048 in (1.22 mm). Insulated conductors shall be stranded into pairs of varying lengths in order to minimize cross-talk.

E. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with the latest ICEA publication of S-80-576.

F. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair sub-units. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.

G. Cable shall meet the physical and electrical requirements of 100 Ohm twisted pair cable as defined by standards. Cable shall conform to Category 3 performance specifications or better.

H. A flooding compound shall be applied over the core and to all surfaces of the shield/armor to resist moisture entry and to inhibit corrosion.

I. The cable core shall be filled with a waterproofing compound and wrapped with a non-hydroscopic core tape.

J. The cables shall contain an overall corrugated, coated aluminum shield, which is electrically continuous over its entire length.

K. The cable shall be finished with a polyethylene jacket, which is sequentially printed with a footage marker at regular intervals.

2.5. VOICE TERMINATION FIELD

A. Voice terminations shall utilize 110 style termination hardware with 25 pairs per row.

B. The mechanical termination shall be capable of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.

C. 4-pair connecting blocks shall be utilized to make electrical connection between terminated cables and cross connect wires. The blocks shall be designed to maintain the cable pair twists as closely as possible to the point of mechanical termination.

D. Base shall employ standoff legs to allow cable routing behind base.

E. Base shall have integral label holder to identify location of cable.

F. Horizontal management shall be via jumper troughs furnished with standoff legs.

G. Vertical cable management shall be via multi pair vertical cable managers designed for use with tower systems.

H. Provide: TE Connectivity / Krone.

2.6. INTRABUILDING FIBER OPTIC CABLE

A. Provide Corning MIC Plenum Cables.

B. This cable shall be suitable for indoor installation in free-air, conduit, tray and/or in innerduct. Cable shall carry on OFNP rating.

C. Cable shall be a Hybrid bundle incorporating both multi-mode and single-mode optics.

D. Cable materials shall be all dielectric.

E. Outer sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. All coatings shall be mechanically strippable without damaging the optical fiber.

F. The glass fiber shall be doped silica core surrounded by a concentric glass cladding. The fiber shall have a graded index. The overall cladding diameter shall be 125 $\pm$ 2μm.

G. Multi-mode optical fibers in each cable shall meet the following specifications:

1.	Transmission Windows	850nm, 1300nm, and minEMBc (Laser)
2.	Core Diameter	50.0 $\pm$ 3μm
3.	Maximum Attenuation	3.0 dB/km @ 850nm; 1.0 dB/km @ 1300nm
4.	Minimum Bandwidth	3500 MHz/km @ 850nm 500 MHz/km @ 1300nm 4700 MHz/km @ minEMBc (Laser)
5.	Fiber Classification	OM4

H. Single-mode optical fibers in each cable shall meet the following specifications:

1.	Transmission Windows	1310nm, 1383nm and 1550nm
2.	Core Diameter	8.3μm
3.	Maximum Attenuation	0.5 dB/km @ 1310nm 0.5 dB/km @ 1383nm 0.5 dB/km @ 1550nm
4.	Fiber Classification	OS2

2.7. INTERBUILDING FIBER OPTIC CABLE

A. Provide Corning Indoor/Outdoor Freedm Loose Tube Gel-Free.

B. Cable shall be suitable for direct burial or duct applications.

C. Cable shall be a Hybrid bundle incorporating both multi-mode and single-mode optics.

D. Cable shall incorporate a corrugated steel armor tape to provide rodent resistance. Other cable materials shall be all dielectric.

E. Cable shall be constructed with a dry water-blocking material.

F. Cable shall be of loose tube construction.

G. Outer sheath shall be polyethylene (PE).

H. The outer sheath shall be marked with the manufacture name, words identifying the cable as fiber optic cable, and sequential length markings. The marking shall be in a contrasting color to the cable jacket.

I. Quantity and type of standards shall be as indicated on the drawings.

J. Multi-mode optical fibers in each cable shall meet the following specifications:

1.	Transmission Windows	850nm, 1300nm, and minEMBc (Laser)
2.	Core Diameter	50.0 $\pm$ 3μm

3.	Maximum Attenuation	3.0 dB/km @ 850nm; 1.0 dB/km @ 1300nm
4.	Minimum Bandwidth	3500 MHz/km @ 850nm 500 MHz/km @ 1300nm 4700 MHz/km @ minEMBc (Laser)
5.	Fiber Classification	OM4

K. Single-mode optical fibers in each cable shall meet the following specifications:

1.	Transmission Windows	1310nm, 1383nm and 1550nm
2.	Core Diameter	8.3μm
3.	Maximum Attenuation	0.5 dB/km @ 1310nm 0.5 dB/km @ 1383nm 0.5 dB/km @ 1550nm
4.	Fiber Classification	OS2

2.8. INDOOR/OUTDOOR FIBER OPTIC CABLE

A. Cable shall be provided wherever it shall run within a wet environment or where it would be exposed to an outdoor condition.

B. Cable shall be suitable for installation both indoors and outdoors.

C. Cable shall retain an OFNP plenum rating to meet the listing requirements per NFPA for use within building premises.

D. Cable shall be loose tube construction.

E. Cable shall constructed with a dry of gel-filled type water blocking material.

2.9. FIBER OPTIC TERMINATION PANELS

A. All fibers shall be terminated on Corning Cable Systems Unicam LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that snaps into the enclosure.

B. The enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.

C. The panel enclosure shall be sized to accommodate the total quantity of fiber strands as described in the specifications and drawings.

D. Termination panels shall be enclosed assemblies. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.

E. The patch panel enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturers recommended minimums.

F. Access to the inside of the patch panel enclosure during installation shall be from the front and rear.

G. The patch panel enclosure shall be configured to require only front access when patching. The enclosure shall provide a physical barrier to access of backbone cables.

H. The enclosure shall incorporate a storage cassette, tray, or other mechanism designed to allow identification, access and termination of individual fibers.

I. The fiber optic patch panel shall be rated to match or exceed the ANSI/TIA/EIA rated wiring terminated on the panel.

J. Provide: Corning CCH connector panels and CCH splice cassettes.

2.10. FIBER OPTIC CONNECTOR

A. The Optical Connector shall be Corning Cable Systems Unicam LC type modular jack. Completed cable assembly shall interface with fiber optic terminal bulkhead feed-through receptacle on Fiber Optic Patch Panel. Supply and install dust caps for terminated fibers.

B. The connector ferrule shall be ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive [or mechanical connection].

C. Boot colors shall be Blue for Singlemode and Aqua for Multimode.

D. Provide:

1. Singlemode: Corning Unicam LC Connectors 95-200-99.
2. Multimode: Corning Unicam LC Connectors 95-05-99-X.

2.11. FIBER OPTIC PATCH CORDS

A. The fiber optic patch cables shall match the core size and type of fiber being patched. The fiber optic patch cables shall utilize tight buffer construction.

B. Fiber Optic jumpers shall incorporate connectors that match the terminations of the fiber being patched. Connector body shall be of materials similar to that used in the proposed couplings.

C. Provide patch cords with connectors compatible with equipment being patched. Verify connector type of active electronic equipment with owner.

D. Provide one optical fiber patch cord per optical fiber strand installed.

E. For the TR patch cords, 80% shall be 3 meters, 10% shall be 4 meters and 10% shall be 7 meters in length from the total number.

2.12. FIBER OPTIC SPLICE ENCLOSURE

A. Splices shall be allowed where required to transition between different fiber optic cable types.

B. The splice enclosure shall be designed specifically for use in the splicing of fiber optic cables and incorporate splice trays. One splice tray shall be used for each fiber bundle. The enclosure and the splice trays shall be designed to organize adequate slack to allow for re-splicing.

C. The splice enclosure shall incorporate strain relief for the incoming cables.

D. Splice enclosure shall be re-usable for system expansion or repair.

E. Provide: Corning CCH-02U connector housing.

PART 3 - EXECUTION

3.1. INTRABUILDING COPPER CABLING (VOICE)

A. Follow cable manufacturer’s cable pulling recommendations. Recommended pulling tensions and pulling bending radii shall not be exceeded. Any cable bent beyond minimum bending radius shall not be installed.

B. All cable shall be free of tension at both ends. A ten foot service loop shall be provided with each backbone cable.

C. Avoid abrasion and other damage to cables during installation.

D. Pulling Lubricant shall be used to ease pulling tensions. Lubricant shall not damage or degrade cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

E. Termination of Backbone Voice cabling shall be accomplished by using five-pair clips.

F. Cables shall be installed in conduit, cable tray, or on J-hooks as shown on the Drawings.

3.2. INTERBUILDING COPPER CABLING (VOICE)

A. All conductors shall be continuous and splice free.

B. Bridge taps shall not be allowed.

3.3. VOICE TERMINATION FIELD

A. Horizontal wiring troughs shall be positioned at the top of each column of termination blocks and between each 100-pair wiring block.

B. Vertical cable managers incorporating metal distributing rings shall be provided for vertical routing of jumper and/or cross-connect wire.

C. Utilize multiple 300 or 900 pair tower systems and corresponding vertical cable managers to create termination fields.

D. Blocks shall identify each pair position by a different color designation. Integral label holders shall allow for easy identification of each location.

E. The Contractor shall be responsible for the cross connect between the station and backbone cabling.

F. Cross connect the center two pair of each station cable to the backbone cable. Use single or two pair cross connect wire for this purpose.

G. Fastening cables directly to support brackets with wire or plastic ties will not be accepted. All cabling shall be neatly laced, dressed and supported. Retainer shall be used on each 110-type block to secure jumper wires on the wiring block(s).

H. Termination blocks shall have a minimum capacity of 20% spare pairs after all horizontal cabling is terminated.

3.4. FIBER OPTIC CABLE

A. Cable shall be continuous and free of splices except in specified splice trays in TR or ER locations. Factory optical fiber splices are not allowed.

B. The fiber manufacturer shall subject all fibers to a minimum tensile proof test equivalent to 100-kpsi. All fibers in each cable shall be guaranteed to meet the stated specifications.

C. Backbone intra-building fiber optic cabling shall be installed via conduit and/or in innerduct in cable tray as illustrated on the drawings.

D. Provide 15 feet of slack in each backbone fiber optic cable. The cable slack shall be coiled and stored in a location to protect it from damage in the TR or ER in the case of inter-building cables. The slack shall be stored in a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

E. Maintain bending radius of twenty times the outside diameter of the cable during installation and ten times the outside diameter with no load.

F. Backbone Fiber Optic Cable shall be installed in protective innerduct where cable is susceptible to damage. This includes areas cable tray and transitions between pathways. The innerduct should extend into the termination and/or storage enclosure(s) at system endpoints.

3.5. FIBER OPTIC CONNECTOR

A. The fiber optic connector shall be installed per manufacturer’s written instructions.

3.6. FIBER OPTIC PATCH PANEL

A. Fiber optic patch panels shall be rack mounted.

B. Install fiber optic patch panels in topmost rack position.

C. Transition outdoor to indoor cables either by splicing factory-terminated pigtails or by the use of a "fan-out" kit. Secure individual fibers in an aramid reinforced tube.

D. Termination hardware shall incorporate a mechanism to secure cable and sub-assemblies and prevent damage.

E. Splicing shall be by the “fusion” method.

F. Direct termination of 250 µm coated fibers shall not be permitted.

3.7. FIBER OPTIC PATCH CORDS

A. The fiber optic patch cords shall be installed per manufacturer’s written instructions.

B. Contractor must coordinate with the owner for installing all patch cords within the TR.

C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

3.8. FIBER OPTIC SPLICE ENCLOSURE

A. The fiber optic splice enclosure shall be installed per manufacturer’s written instructions.

END OF SECTION 271300

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SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end horizontal structured cabling system throughout the campus and premises. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct and termination components, ancillary equipment, testing, labeling and documentation of cables and connectors.

B. Complete product procurement and installation shall comply with the campus or owner’s latest telecommunication and Information Technology standards documents.

PART 2 - PRODUCTS

2.1. MANUFACTURER(S) AND SOLUTIONS

A. Acceptable indoor/premise end to end solutions for horizontal copper and components:

1. TE Connectivity TrueNet.

B. Acceptable indoor/outdoor end to end solutions for horizontal copper and components:

1. TE Connectivity Sealed Industrial

2.2. BASIC ENVIRONMENTAL REQUIREMENTS

A. Cabling shall be suitable for environment in which they are to be installed.

B. Cabling shall be plenum rated within interior premise installations.

C. Cabling shall be outdoor rated within exterior installations subject to outdoor environmental conditions.

2.3. STANDARD HORIZONTAL STATION CABLE

A. Cable shall consist of 4 pair #24 AWG insulated solid copper conductors. Each pair shall be unshielded and twisted.

B. Transmission characteristics of the cables shall exceed Category 6 performance as defined by industry standards.

C. The jacket color for communication cables shall be Blue.

D. Provide:

1. Indoor: TE Connectivity TrueNet TE620P.
2. Outdoor: TE Connectivity TrueNet TE620OSP.

2.4. INTERNAL EDUCATION NETWORK CABLE IN CISCO NETWORKING AND CABLING LABS:

A. Cable shall consist of 4 pair #24 AWG insulated solid copper conductors. Each pair shall be unshielded and twisted.

B. Transmission characteristics of the cables shall exceed Category 6 performance as defined by industry standards.

C. The jacket color for communication cables shall be White.

D. Cable served by the poke-thrus serving the student desks shall be bundled and Velcro wrapped independently between the internal education (White) cable and the standard horizontal (Blue) cable within the student desk raceways. Cable must not mix into one bundle.

E. Provide:

1. Indoor: TE Connectivity TrueNet TE620P.

2.5. HORIZONTAL STATION INDOOR/OUTDOOR CABLE

A. Cable shall be provided wherever it shall run within a wet environment or where it would be exposed to an outdoor condition.

B. Transmission characteristics of the cables shall meet full Category 6 performance as defined by industry standards.

C. Cable shall be suitable for installation both indoors and outdoors.

D. Cable shall be suitable for both direct burial and underground conduit installations.

E. Cable shall retain an OFNP plenum rating to meet the listing requirements per NFPA for use within building premises.

F. Cable shall be constructed with a dry or gel-filled type water blocking material.

2.6. INDOOR JACKS

A. Jacks shall be non-keyed 8-pin 8 conductor (8P8C) modular jacks.

B. Data termination hardware shall meet full Category 6 performance specifications as defined by industry standards.

C. Jacks shall be UL verified and listed.

D. Color of the communication jack shall be Blue.

E. Provide: TE Connectivity TrueNet 6830 1 830-06.

2.7. INTERNAL EDUCATION NETWORK JACKS IN CISCO NETWORKING AND CABLING LABS:

A. Jacks shall be non-keyed 8-pin 8 conductor (8P8C) modular jacks.

B. Data termination hardware shall meet full Category 6 performance specifications as defined by industry standards.

C. Jacks shall be UL verified and listed.

D. Color of the communication jack shall be White.

E. Provide: TE Connectivity TrueNet 6830 1 830-01.

2.8. OUTDOOR JACKS

A. In outdoor conditions as indicated on drawings provide IP67 rated jacks.

B. Jacks shall be terminated and installed within appropriate outdoor rated stainless steel faceplate as indicated by manufacturer instructions.

C. Provide weather seals on outlets as needed to equal that of outdoor rated products in the project and per manufacturer’s recommendations.

D. Provide IP67 rated screw on covers produced by the same jack manufacturer for every outdoor jack installed.

E. Data termination hardware shall meet full Category 6 performance specifications as defined by industry standards.

F. Jacks shall be UL verified and listed.

2.9. TELECOM OUTLET - STANDARD INDOOR

A. The combined faceplate and connector jack assembly is referred to as the Information Outlet (IO).

B. Connector assemblies shall utilize modular jacks as specified in paragraph 2.2.

C. Outlet faceplates shall incorporate recessed designation strips for identifying labels. Designation strips shall be fitted with clear plastic covers.

D. The faceplate of the IO shall be constructed of high impact plastic (except where noted otherwise).

E. Jacks configurations should be in an angled position.

F. Single-gang faceplates shall be 2.75 x 4.5 inches.

G. Faceplates shall be UL listed.

H. Color of the wall plate shall be Ivory or White depending on electrical outlet color to match.

I. Provide:

1. Faceplate: TE Connectivity TrueNet 6644 1 174-01.
2. Jack: TE Connectivity TrueNet 6830 1 830-06.
3. Dust Cover: TE Connectivity TrueNet 6645 1 160-01.

2.10. WIRELESS COMMUNICATION OUTLET

A. The combined faceplate and connector jack assembly is referred to as the Information Outlet (IO).

B. Connector assemblies shall utilize modular jacks as specified in paragraph 2.2.

C. Outlet faceplates shall incorporate recessed designation strips for identifying labels. Designation strips shall be fitted with clear plastic covers.

D. The faceplate of the IO shall be constructed of high impact plastic (except where noted otherwise).

E. Jacks configurations should be in an angled position.

F. Single-gang faceplates shall be 2.75 x 4.5 inches.

G. Faceplates shall be UL listed.

H. Color of the wall plate shall be Ivory or White depending on electrical outlet color to match.

I. Provide:

1. Faceplate: TE Connectivity TrueNet 6644 1 174-01.
2. Jack: TE Connectivity TrueNet 6830 1 830-06.
3. Dust Cover: TE Connectivity TrueNet 6645 1 160-01.

2.11. TELECOM OUTLET - STANDARD OUTDOOR

A. Provide for all wired and wireless communications outlets located in the exterior or subject to harsh and wet conditions.

B. Faceplates shall be IP67 rated faceplate.

C. Faceplate shall be stainless steel and tamper resistant.

D. Provide weather seals on faceplate as needed to equal that of outdoor rated products in the project and per manufacturer’s recommendations.

E. The combined faceplate and connector jack assembly is referred to as the Information Outlet (IO).

F. Connector assemblies shall utilize modular jacks as specified in paragraph 2.3.

G. Outlet faceplates shall include area for integrating waterproof labels. Designation strips shall be fitted with clear waterproof covers.

H. Single-gang faceplates shall be 2.75 x 4.5 inches.

I. Faceplates shall be UL listed.

J. Provide: TE Connectivity Sealed Industrial product solutions.

2.12. TELECOM WALL PHONE OUTLET

A. Faceplate shall be stainless steel flush to utilize a single modular jack.

B. Faceplate shall have standard mounting stubs on top and bottom suitable for wall mounting a standard phone directly over it.

C. Outlet shall be placed at a location providing 12” x 12” clearance at all sides to accommodate the phone.

D. Provide:

1. Faceplate: TE Connectivity TrueNet 6644 1 174-01.
2. Jack: TE Connectivity TrueNet 6830 1 830-06.

2.13. TELECOM OUTLET - MODULAR FURNITURE

A. Outlet module shall be formulated to fit all jacks in row for use within furniture cabling provision or raceway. Contractor must confirm compatibility of outlet with the raceway manufacturer prior to ordering.

B. Outlet module shall allow jacks to retain the configuration of the standard information outlets shall accommodate easy to read labels configured horizontally.

C. Color of the outlet module should be Ivory or White depending on electrical outlet color to match.

2.14. TELECOM OUTLET - FLOORBOX/POKE-THRU

A. Faceplate shall include mounting slots for accommodating required jacks within the floorbox/poke-thru. Contractor must confirm compatibility of faceplate with the floorbox/poke-thru

B. Faceplate shall be able to fit within standard NEMA provision as well as low voltage floorbox and poke-thru provisions.

C. Color of the faceplate shall be Ivory or White depending on electrical outlet color to match.

2.15. TELECOM OUTLET - RACEWAY

A. Outlet module shall be formulated to fit all jacks for use within the raceway’s provisions. Contractor must confirm compatibility of outlet with the raceway manufacturer.

B. Outlet module shall allow jacks to retain the configuration of the standard information outlets shall accommodate easy to read labels configured horizontally.

C. Color of the outlet module should be Ivory or White depending on electrical outlet color to match.

2.16. HORIZONTAL STATION CABLE PATCH PANEL

A. The data patch panel shall utilize modular jacks as described in paragraph 2.4.

B. Patch panels shall be 19” wide and rack mounted.

C. Individual patch panels shall contain a maximum of 48 ports.

D. The data patch panel as a system shall be rated to match or exceed the ANSI/TIA/EIA rated wiring terminated on the panel.

E. Patch panel shall be complete with rear strain relief mechanism for the incoming cables.

F. The patch panel shall have integral designation strips to identify each port on the front and rear of the panel.

G. Patch panels shall have a minimum of 20% spare ports.

H. Provide: TE Connectivity 6653 1 679-48.

2.17. COMMUNICATIONS INDOOR OUTLET PATCH CORDS

A. Patch cords shall be factory manufactured by the same manufacturer providing the horizontal cabling and meet the requirements of Category 6 cabling.

B. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.

C. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.

D. Provide one patch cord per installed jack.

E. All workstation patch cords shall be 14 feet in length.

F. For the TR patch cords, 80% shall be 7 feet, and 20% shall be 14 feet in length from the total number.

2.18. COMMUNICATIONS OUTDOOR OUTLET PATCH CORDS

A. In outdoor conditions as indicated on drawings provide IP67 rated patch cords.

B. Patch cords shall be from the same manufacturer as the outdoor rated jacks submitted for installation.

C. Patch cords shall be factory manufactured by the same manufacturer providing the horizontal cabling and meet the requirements of Category 6 cabling.

D. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.

E. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.

F. Provide patch cord for all outdoor drops.

G. Each patch cord shall be 5 feet in length.

PART 3 - EXECUTION

3.1. HORIZONTAL DATA STATION CABLE AND TERMINATIONS

A. All horizontal Data Station Cables shall terminate on modular patch panels in their respective Telecommunications Rooms (TR) or Equipment Room (ER) as specified on the drawings.

B. The maximum station cable drop length shall not exceed 90-meters. This length shall be measured from the patch panel in the wiring closet to the outlet in the work area. The Contractor is responsible for installing station cabling in a fashion to avoid runs that exceed this distance. Any areas that violate the above constraints shall be identified and reported to the Consultant prior to installation.

C. All cables shall be continuous and splice-free.

D. During pulling operation provide adequate resources to observe cable at all points of duct entry and exit.

E. Avoid abrasion and other damage to cables during installation.

F. All cable shall be installed free of tension at both ends. In cases where the cable must bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.

G. Cables shall be supported according to applicable codes. J-hooks used for cable support shall be manufactured solely for the purpose of supporting communication cables.

H. Supports should be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 12-inches, another support shall be used.

I. Cable shall never be supported by the ceiling grid.

J. Cables shall not be attached to existing cabling, plumbing or steam piping, ductwork, ceiling supports or the outside of existing electrical or communications conduit.

K. Manufacturer’s minimum bend radius specifications shall be observed at all times. Cable ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.

L. Cable sheaths shall be protected from damage by sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable. Bushings shall be used at both ends of all EMT and rigid steel conduit.

M. Maintain the following minimum separation distances between power and data cables.

Condition	Minimum Separation Distance		
	< 2kVA	2-5 kVA	>5kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways	5”	12”	24”
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	2.5”	6”	12”
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway		3”	6”
Electrical motors and transformers			48”

N. Maintain the following minimum separation distances between data cables and specific electromagnetic interference sources:

Source of Disturbance	Minimum Separation

Fluorescent lamps	6”
Neon lamps	6”
Mercury vapour lamps	6”
High-intensity discharge lamps	6”
Arc welders	6”
Frequency induction heating	40”

O. Cables shall be routed through channel in modular furniture. Communication cabling shall not run in channel with power wiring.

P. Information Outlets shall be flush mounted on wall-mounted boxes, in floor-mounted boxes, and in modular furniture as shown on Drawings.

Q. All data and voice cables shall be positioned on termination hardware in sequence of the Outlet I.D. starting with the lowest number.

R. Termination hardware (Blocks and Patch Panels) positioning and layout must be reviewed by the Consultant prior to construction. The review does not exempt the Contractor from meeting any of the requirements stated in this document.

S. Patch panels shall be installed to allow for future cables to be added without disrupting existing installation.

T. Cables shall have a 12” service loop in outlet box or supported properly above ceiling.

3.2. JACKS

A. Jacks shall be wired per T-568B pin outs.

3.3. INFORMATION OUTLET

A. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

B. Outlet boxes shall be secured to building with minimum of two mechanical fasteners per box. Adhesive fasteners are not allowed.

C. All extra openings to be filled with blank inserts.

3.4. COMMUNICATIONS PATCH PANEL

A. Panels shall be fully populated with jacks.

B. Install copper patch panels below fiber optic patch panels in telecommunications rack.

3.5. HORIZONTAL DATA STATION CABLE PATCH CORDS

A. The patch cords shall be installed per manufacturer’s written instructions.

B. Contractor must coordinate with the owner for installing all patch cords within the TR.

C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

3.6. FIBER OPTIC CONNECTOR

A. The fiber optic connector shall be installed per manufacturer’s written instructions.

3.7. FIBER OPTIC PATCH CORDS

A. The fiber optic patch cords shall be installed per manufacturer's written instructions.

B. Contractor must coordinate with the owner for installing all patch cords within the TR.

C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

END OF SECTION 271500